

CHAPTER 2

AMMUNITION AND MAGAZINES AND MISSILE HANDLING

In the preceding chapter, you learned about the raw materials that are used to make up explosives and pyrotechnics. In this chapter, you will study Navy gun-type ammunition and its basic construction features and functions. We will identify the types of projectiles and fuzes used in the Navy and describe the systems used to identify ammunition. We will also describe magazines and their sprinkler and alarm systems. Finally, we discuss some of the equipment, training requirements, and safety precautions pertaining to the handling and storage of ammunition. In this chapter, you are assumed to have an understanding of the Navy's Maintenance and Material Management (3-M) Systems. You may wish to review some of the 3-M Systems fundamentals before continuing with this chapter.

AMMUNITION

LEARNING OBJECTIVE: Describe the classification, components, and features of Navy gun Ammunition.

In a general sense, ammunition includes anything that is intended to be thrown at or put in the path of the enemy to deter, injure, or kill personnel or to destroy or damage materials. This chapter is devoted chiefly to gun ammunition. In this section, we describe how ammunition is classified, the common components of gun ammunition, and some of the actual types of gun ammunition in use today.

AMMUNITION CLASSIFICATION

Gun ammunition is classified in several different ways, depending on your needs. It may be classified by gun size, assembly configuration, service use, or purpose and construction.

Classification by Size of Gun

Gun ammunition is most commonly classified by the size of the gun in which it is used. In addition to designations of bore diameter, such as 25-mm, 76-mm, or 5-inch, the length of the gun bore in calibers (inches) is also used as a means of classification. Thus a 5-inch, 54-caliber projectile is one used in a gun having a bore diameter of 5 inches and a bore length of 54 times 5 inches, or 270 inches.

Classification by Assembly

The three types of ammunition classified by assembly are shown in figure 2-1.

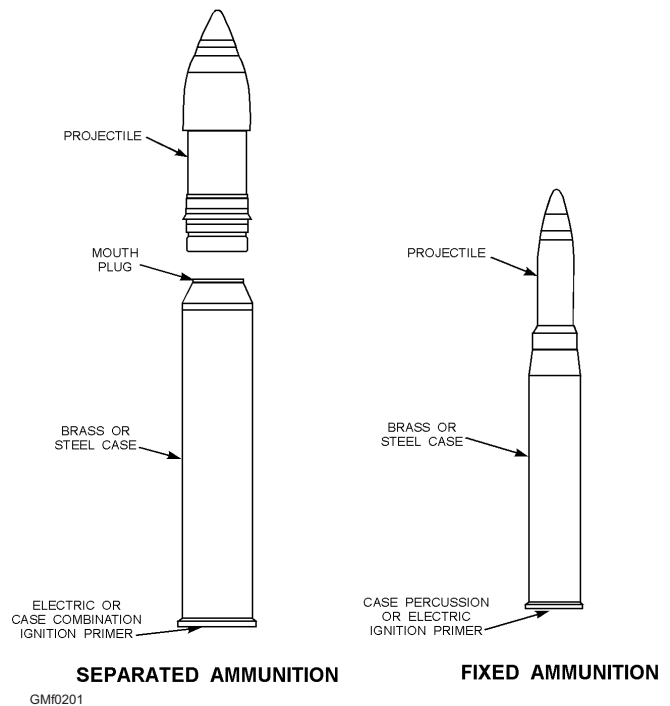


Figure 2-1.—Typical Navy gun ammunition assemblies.

FIXED AMMUNITION.—The fixed class applies to ammunition that has the cartridge case crimped around the base of the projectile. The primer is assembled in the cartridge case. The projectile and the cartridge case, containing the primer and propellant charge, all form one unit as a fixed round of ammunition. Guns through 76-mm use fixed ammunition.

SEPARATED AMMUNITION.—This class applies to ammunition that consists of two units—the projectile assembly and cartridge case assembly. The projectile assembly consists of the projectile body containing the load, nose fuze, base fuze, and auxiliary detonating fuze, as applicable. The cartridge case assembly consists of the cartridge case, primer, propellant charge, wad, distance piece, and a plug to close the open end of the cartridge case. The projectile and cartridge are rammed into the gun chamber together as one piece though they are not physically joined. Separate ammunition has been produced in gun sizes of 5-inch, 38-caliber through 8-inch, 55-caliber guns.

SEPARATE-LOADING (BAGGED GUN) AMMUNITION.—This class applies to gun sizes 8 inches and larger. Separate-loading ammunition does not contain a cartridge case; the propellant charge is loaded in silk bags that are consumed during the combustion of the propellant when fired from the gun. The projectile, propellant charge, and primer are loaded separately. There are currently no naval guns in use that use separate-loading ammunition.

Classification by Service Use

For economy and safety, gun ammunition is assembled and classified by service use as follows:

- **Service:** Ammunition for use in combat. These projectiles carry explosive, illuminating, or chemical payloads.
- **Target and Training:** Ammunition for training exercises. The projectiles are comparable in weight and shape to those of service ammunition but are of less expensive construction and normally contain no explosive. Variable time, nonfragmenting (VT NONFRAG) projectiles are an exception in that they

are for training purposes and have a combination black powder-pyrotechnic color-burst element.

- **Dummy or Drill:** Any type of ammunition assembled without explosives, or with inert material substituted for the explosives, to imitate service ammunition. The ammunition may be made of metal or wood. Dummy or drill ammunition is used in training exercises or in testing equipment. It is normally identified as dummy cartridges, dummy charges, or drill projectiles. Drill projectiles will not be fired from any gun.

Classification by Purpose and Construction

Service projectiles are classified by their tactical purpose as one of the following types: penetrating, fragmenting, and special purpose. Since targets differ in design and purpose, projectiles must also differ in their construction to make them more effective. If you were to cut open, for purposes of inspection, the different types of projectiles listed previously (other than small arms), you would find their construction and characteristics are common. For example, penetrating projectiles have thick walls and a relatively small cavity for explosives, while fragmenting projectiles are thin-walled and have a relatively large cavity for the explosives. Because of this, projectiles are also classified by their construction.

GUN AMMUNITION

Gun ammunition consists of a projectile and a propelling charge. In this section we will describe a typical projectile, the different types of projectiles in use, propelling charges, and fuzes currently in use.

Projectiles

The projectile is the component of ammunition that, when fired from a gun, carries out the tactical purpose of the weapon. While some types of projectiles are one piece, the majority of naval gun projectiles are assemblies of several components. All the projectiles to be briefly discussed by classification in this chapter have several common features as described in the following paragraphs and as illustrated in figure 2-2.

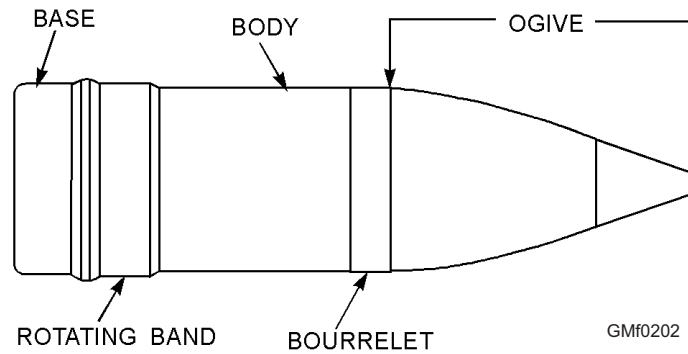


Figure 2-2.—External features of a typical gun projectile.

OGIVE.—The ogive is the curved forward portion of a projectile. The curve is determined by a complex formula designed to give maximum range and accuracy. The shape of the ogive is generally expressed by stating its radius in terms of calibers. It may be a combination of several arcs of different radii.

BOURRELET.—The bourrelet is a smooth, machined area that acts as a bearing to stabilize the projectile during its travel through the gun bore. Some projectiles have only one bourrelet (forward); the rotating band serves as the bearing surface in the rear. Still other projectiles have one bourrelet forward and one or two aft, the after one being located adjacent to and either forward and/or aft of the rotating band. Bourrelets are painted to prevent rusting.

BODY.—The body is the main part of the projectile and contains the greatest mass of metal. It is made slightly smaller in diameter than the bourrelet and is given only a machine finish.

ROTATING BAND.—The rotating band is circular and made of commercially pure copper, copper alloy, or plastic seated in a scored cut in the after portion of the projectile body. In all minor and medium caliber projectiles, rotating bands are made of commercially pure copper or gilding metal that is 90 percent copper and 10 percent zinc. Major caliber projectile bands are of cupro-nickel alloy containing 2.5 percent nickel or nylon with a Micarta insert. As a projectile with a metallic band passes through the bore of the gun, a

certain amount of copper will be wiped back on the rotating band and will form a skirt of copper on the after end of the band as the projectile leaves the muzzle of the gun. This is known as fringing and is prevented by cutting grooves, called cannelures, in the band or by undercutting the lip on the after end of the band. These cuts provide space for the copper to accumulate. The primary functions of a rotating band are:

1. To seal the forward end of the gun chamber against the escape of the propellant gas around the projectile,
2. To engage the rifling in the gun bore and impart rotation to the projectile, and
3. To act as a rear bourrelet on those projectiles that do not have a rear bourrelet.

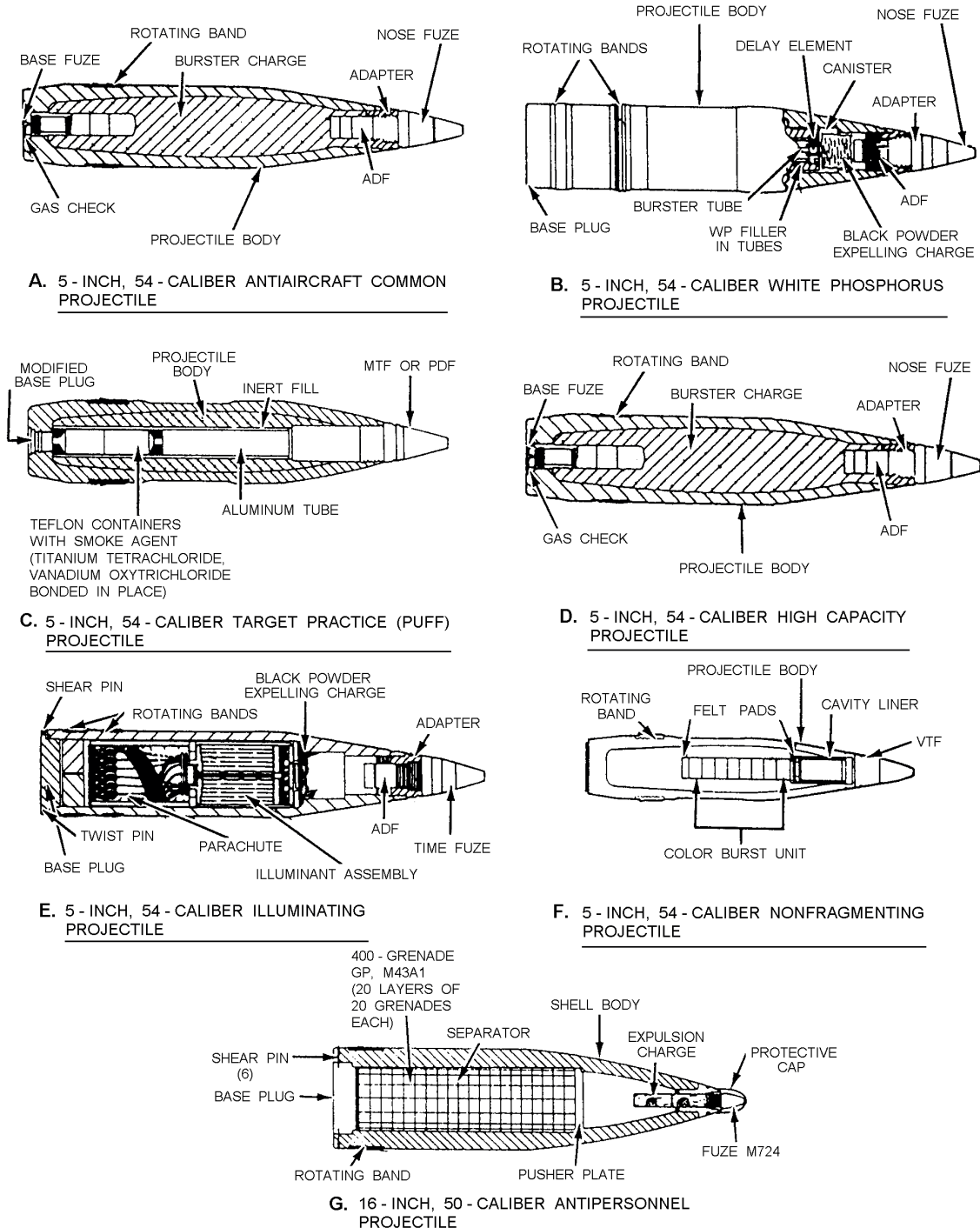
BASE.—The base is the after end of the projectile. A removable base plug is provided in projectiles that are loaded through this end. A fuze hole may be drilled and tapped in the center of this base plug. Projectiles with large openings in the nose for loading through that end require no base plug. In such cases, however, the solid base of the projectile may be drilled in the center to receive a base fuze or tracer if desired. The edge formed by the side walls and the base is usually broken slightly to give additional range. Some projectiles are tapered aft of the rotating band, a shape known as boat tailed. Projectiles with plastic bands may have full caliber boat tails for optimum aerodynamic shape.

Types of Projectiles

Projectiles are also classified by their tactical purpose. The following are descriptions of the common projectile types (fig. 2-3).

ANTIAIRCRAFT (AA).—AA projectiles are designed for use against aircraft; they have no base fuze. Otherwise, they are substantially the same as the high-capacity (HC) projectiles described later.

ANTIAIRCRAFT COMMON (AAC).—AAC projectiles are dual-purpose projectiles combining most of the qualities of the AA type with the strength necessary to penetrate mild steel plate (fig. 2-3, view A). However, AAC projectiles do not have the penetrative ability of common (COM) projectiles. The type of fuzing will depend on the use. Fuze threads are provided in the nose and in the base. AAC projectiles are normally equipped with a mechanical time fuze (MTF) and an auxiliary detonating fuze (ADF).



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Figure 2-3.—Common projectile types.

Dual-purpose action is accomplished by a time setting for airburst or by setting MTFs on "safe" or for a time longer than flight to target to permit the base detonating fuze (BDF)(delay) to function for penetration. By substituting a point detonating fuze (PDF) for the MTF, these projectiles are converted to HC for surface burst.

ARMOR-PIERCING (AP).—AP projectiles are designed to penetrate their caliber of class A armor plate. A 5-inch projectile will penetrate 5 inches of armor, and so on. They are characterized in most cases by a low explosive-charge-to-total-weight ratio and by their windshields and AP caps. Windshields are light nosepieces of false ogives designed to give suitable flight characteristics—they are made of mild steel, steel stamping, or aluminum. Windshields are screwed to the AP cap and are staked in place. AP caps are made of the same kind of steel as the projectile bodies. The cap breaks down the initial strength of the armor plate and provides support to the pointed nose of the projectile as it begins to penetrate the target. The cap also increases the effective angle of obliquity at which the projectile may hit and penetrate. The cap is peened and soldered to the nose. AP projectiles are fuzed only in the base. The fuzes must not be removed except at ammunition depots. Powdered dye colors are loaded in the windshield of most AP projectiles. These dye colors allow a firing ship to identify its splashes, since each ship is assigned a specific color. The dye is placed inside the windshield in a paper container. There are ports in the forward portion of the windshield that admit water when the projectile strikes the surface and breaks the port seals. Other ports in the after portion of the windshield are pushed out by pressure of the water inside the windshield. The dye is dispersed through these after ports.

COMMON (COM).—COM projectiles are designed to penetrate approximately one-third of their caliber of armor. A 5-inch projectile would penetrate 1.66 inches of armor, and so on. They differ from AP projectiles in that they have no hardened cap and have a larger explosive cavity.

CHEMICAL.—Chemical projectiles may be loaded with a toxic, harassing, or smoke-producing agent. Of the smoke agents, white phosphorous (WP) is the most frequently used. WP projectiles (fig. 2-3, view B) are designed to produce heavy smoke and, secondarily, an incendiary effect. The small WP containers are expelled and then scattered by a delayed action burster charge that is ignited by a black powder expelling charge. Other chemical loads are dispersed in a similar manner.

PUFF.—Puff projectiles (fig. 2-3, view C) are nonexplosive projectiles used as practice (spotting) rounds. They are designed to produce dense smoke clouds approximating those of high-explosive rounds.

DRILL.—Drill projectiles are used by gun crews for loading drills and for testing ammunition hoists and other ammunition-handling equipment. They are made of economical but suitable metals and are designed to simulate the loaded service projectile represented as to size, form, and weight. They may be solid or hollow. If hollow, they may be filled with an inert material to bring them to the desired weight. This latter type is closed with a base or nose plug or both, as appropriate.

DUMMY.—Dummy projectiles are reproductions of projectiles that may be produced from a variety of materials for a number of purposes. Drill projectiles are dummy projectiles in that they are not to be fired from a gun. However, all dummy projectiles are not drill projectiles. Dummy projectiles may be made for display, instruction, or special tests.

HIGH CAPACITY (HC).—HC projectiles are designed for use against unarmored surface targets, shore installations, or personnel. They have a medium wall thickness and large explosive cavities. Large HC projectiles (fig. 2-3, view D) are provided with an auxiliary booster to supplement the booster charge in the nose of the main charge. With threads in both the nose and base, HC projectiles may receive a variety of fuzes or plugs to accomplish different tactical purposes. An adapter ring (or rings) is provided on the nose end of most HC projectiles to allow installation of PDFs or nose plug and ADFs with different size threads. An adapter is removed for larger fuzes. HC projectiles are normally shipped with a PDF installed in the nose. The base fuze that is shipped installed in the projectile may not be removed except at an ammunition depot.

HIGH EXPLOSIVE (HE).—Small caliber projectiles with an HE designation are designed to receive a large explosive charge. Structurally, they resemble the HC type in larger caliber projectiles. They have no base fuze; a nose fuze is issued installed in the projectile.

HIGH EXPLOSIVE-POINT DETONATING (HE-PD).—These projectiles feature PDFs that may require the use of an ADF and fuze cavity liner (FCL). If the PDF is of the new, short-intrusion type, no ADF is required since its function has been incorporated. Also, the FCL has been integrated with a fuze thread adapter in some cases.

HIGH EXPLOSIVE-VARIABLE TIME (HE-VT).—These projectiles may be fuzed with either

the short-intrusion variable time fuze (VTF) and adapter or with the deep-intrusion fuze and FCL.

HIGH EXPLOSIVE-MECHANICAL TIME/POINT DETONATING (HE-MT/PD).—

This projectile is similar to the HE-MT projectile except that the nose time fuze has a point detonating backup. This causes a self-destructive action on surface impact in case of airburst function failure due to clock failure or surface impact before expiration of the set time.

ILLUMINATING (ILLUM).—ILLUM projectiles (fig. 2-3, view E) are made with thin walls. Each contains a time fuze, an ADF, a small black powder expelling charge behind the ADF, an assembly consisting of a pyrotechnic star or candle with a parachute, and a lightly held base plug. The time fuze serves to ignite the expelling charge. Explosion of the expelling charge forces out the base and the illuminating assembly and ignites the star or candle.

ROCKET-ASSISTED PROJECTILE (RAP).—To increase the range and effectiveness of 5-inch gun systems, the RAP was developed as an addition to existing gun-type ammunition. It has a solid-propellant rocket motor that can impart additional velocity and provide extended range compared to standard projectiles.

SELF-DESTRUCT, NONSELF-DESTRUCT (SD, NSD).—Certain older projectiles used in AA firing have a feature that detonates the explosive filler at a designated range to prevent the round from hitting other ships in the task force. Some VTFs contain this self-destruct device. Also, some tracers in small caliber projectiles are made to burn through to the explosive filler. In either case, the projectile carries the designation SD. Projectiles without one of these features are designated NSD.

TARGET (TAR).—These are blind-loaded (BL) projectiles. They are special projectiles designed for target practice, ranging, and proving ground tests. As target practice ammunition, they are used to train gunnery personnel. They may be fitted with a tracer (BL-T) or plugged (BL-P).

VARIABLE TIME-NONFRAGMENTING (VT-NONFRAG).—Some VT-NONFRAG projectiles (fig. 2-3, view F) are loaded to avoid rupturing the body and spreading fragments when the fuze functions. However, sometimes the projectile ogive breaks up into low-velocity fragments. They are designed for use in AA target practice, particularly against expensive drone targets, for observing the results of firing without

frequent loss of the drones. These projectiles have fillers of epsom salts or other inert material to give the projectile the desired weight. A color-burst unit, consisting of pellets of black powder and a pyrotechnic mixture, is placed in a cavity drilled into the center of the inert filler. The color-burst unit is ignited through the action of the nose fuze and the black-powder pellets. The color-burst unit may be one of several colors that exits through the fuze cavity and ruptured projectile.

ANTIPERSONNEL. —The antipersonnel projectile (fig. 2-3, view G) consists of a projectile body, an expulsion charge, a pusher plate, a payload of 400 individually fuzed grenades, and a base plug. The M43A1 grenade is an airburst rebounding-type munition. The antipersonnel projectile is unique to the 16"/50 gun.

Propelling Charges

Propelling charges are mixtures of explosives designed to propel projectiles from the gun to the target. In fixed ammunition, the propelling charge and projectile are assembled together in a case and handled as one unit. The principal component parts are the brass or steel cartridge case, the primer, and the propellant powder charge. In the separated ammunition, the propelling charge and projectile are assembled separately—they are stored and handled as separate units until they are loaded into the gun. The propelling charge of the separated ammunition round consists of the propellant primer, details, and closure plug assembled into the metal case. The propelling charges

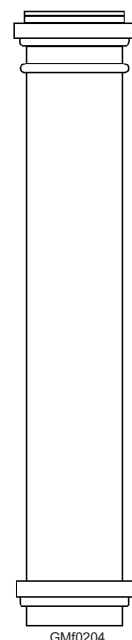


Figure 2-4.—Tank-type 5"/54 cartridge case container.

of separate loading ammunition are made up in sections (bag charges) separate from the projectile and primer. Propelling charges for all calibers of ammunition have some common features. There are two basic categories into which these features can be grouped—case ammunition and bag charges. Saluting, reduced, and clearing charges have components that are the same as case ammunition, so they are included with case ammunition.

Propelling charges for small and medium caliber guns are assembled with primer and powder enclosed in a brass or steel container called a cartridge case. Assembly of the entire charge in a single, rigid, protective case increases the ease and rapidity of loading and reduces the danger of flarebacks. Also, the case prevents the escape of gases toward the breech of the gun; it expands from the heat and pressure of the burning powder and forms a tight seal against the chamber.

In case-type propelling charges, the propelling charge and primer are contained in a cylindrical metal cartridge case. This ammunition is of two types—fixed and separated. In fixed ammunition the primer, propelling charge, and projectile are assembled into a single unit that may be loaded into the gun in a single operation. In separated ammunition, the primer and

propelling charge are contained in a cartridge case as a separate plugged unit; the projectile is also a complete, separate unit.

A complete round of separated ammunition consists of two pieces—a projectile and a cylindrical metal cartridge case sealed by a cork or plastic plug. Separated ammunition is used in 5-inch guns and their cases are kept in airtight tanks (fig. 2-4), until they are to be fired.

A complete round of fixed ammunition is one piece, with the cartridge case crimped to the base of the projectile. Fixed 76-mm rounds are also kept in tanks, but smaller calibers and small arms are stowed in airtight boxes, several rounds to a box.

The insides of both the fixed and separated ammunition cartridge cases are quite similar. Figures 2-5 and 2-6 show the main components of both types of cartridge cases. The base of the primer fits into the base of the case so that firing pin the gun lines up with and contacts the primer when the breech is closed. A black-powder ignition charge runs the full length of the perforated stock or tube of the primer.

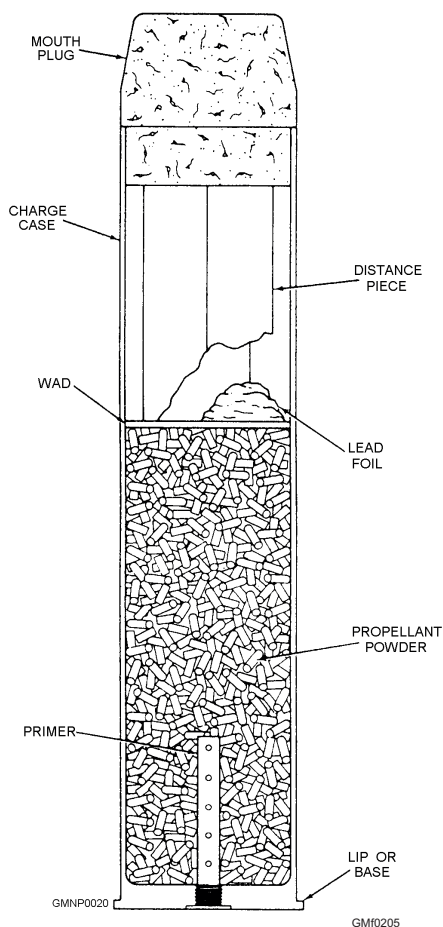


Figure 2-5.—Typical cartridge case for separated ammunition, sectional view.

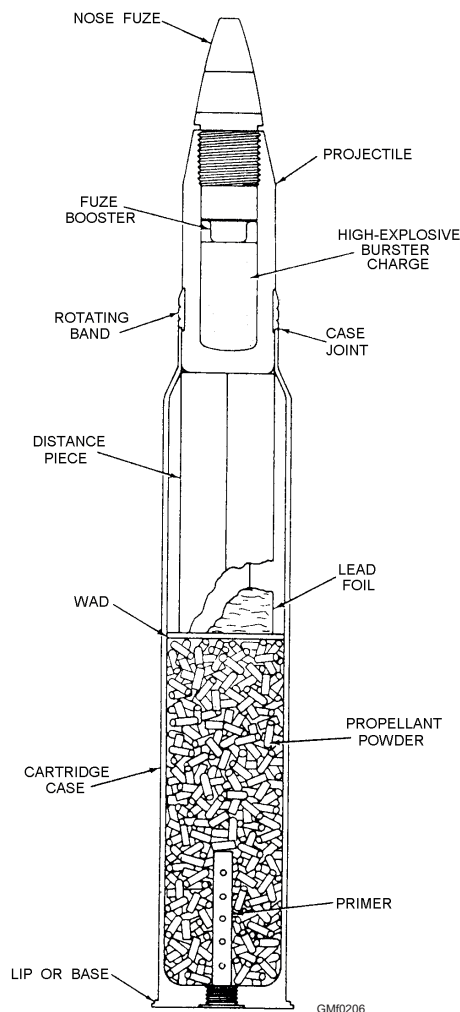


Figure 2-6.—Typical round of fixed ammunition, cartridge case assembled with projectile, sectional view.

The 5-inch ammunition being issued to the fleet is assembled with case electric primers. The most notable exception to this is the 76-mm round that uses a percussion-only primer.

Look at the cartridge case in figure 2-5 again. When the gun fires, the case expands under the powerful pressure of the burning propellant gas, then must contract so that it can be removed from the chamber. It must not stick to the chamber walls nor may it crack. For a long time, only seasoned brass cases could be relied on to perform correctly. During World War II, when the supply of brass became critical, metallurgists developed a steel case that has since almost completely replaced brass. Regardless of what cases are made of, used cases are often called "fired brass." Steel cartridge cases are no longer reloaded and reused; however, since the cartridge tanks are required for reuse, the cases may be returned in the empty tank for the scrap value.

Immediately after firing, and before returning the cases to their tanks, the ejected cases (3-inch and larger) should be stood on their bases to permit residual gases (small amounts left over after firing) to escape completely. Other cases should be replaced in the original containers, tagged, and stowed.

In the center of the base of the case is the threaded hole for the primer. The case tapers slightly toward the forward end so that it can be withdrawn from the chamber without binding. A rim at the base is engaged by the gun's extractors. In fixed ammunition, the case often has a bottleneck in which the projectile is crimped.

The propellant powder in the case is the seven-perforation kind we have already discussed. (Small caliber grains have one perforation.) The powder is weighed out with great precision and loaded into the case at the ammunition manufacturing facility. Since it does not take up all the space inside the case, and since it would be dangerous for the powder to have a lot of room to rattle around in, it is tightly packed and sealed under a cardboard or pyralin wad. The wad is kept tight by a triangular cardboard distance piece. The distance piece bears up against the plug that closes the mouth of the case. In fixed ammunition, the case is sealed by the projectile base.

A small amount of lead foil included in each propelling charge functions to clear the bore of the metal fouling that scrapes off the projectile rotating band onto the rifling as the projectile passes through the barrel.

Reduced Charge.—A reduced charge is one that contains less than the service load of powder. Reduced charges are often used to fire on reverse-slope targets (discussed in chapter 7) and may be used in target practice to decrease wear on the gun.

Clearing Charge.—When a round fails to seat fully upon being rammed into the gun chamber (preventing closure of the breech), or when the propelling charge fails to function, the projectile may be fired by extracting the full-sized case and loading a clearing charge that is shorter.

Saluting Charge.—These are charges used when firing a gun to render honors. Since no projectile is involved in such firing, the charge consists of a cartridge case containing a black-powder load and a primer. Ships normally employ 40-mm or 3-inch guns for saluting. Saluting charges for these guns are issued completely assembled, with no replacement components.

FUZES

LEARNING OBJECTIVE: Describe the different types and functions of fuzes used on current 5-inch and 76-mm projectiles.

In chapter 1 you learned that the burster charge of a projectile is relatively insensitive and requires an explosive train. This train begins with a very small amount of sensitive initiating explosive that initiates the chain reaction required to detonate the less sensitive main burster charge.

The component that sets off the projectile bursting charge is the fuze. No matter how complicated or simple the construction or function of the fuze is, it always serves the same purpose.

INERTIA

The nature of the fuze mechanism depends, of course, on what type of fuze it is. All fuze mechanisms depend on certain forces either to start their functioning or to keep them functioning. These forces develop when the projectile is fired, when it flies through the air, or at the end of the flight. In the sequence of their development, these forces are called setback, angular acceleration, centrifugal force, creep, and impact. They are worth explaining.

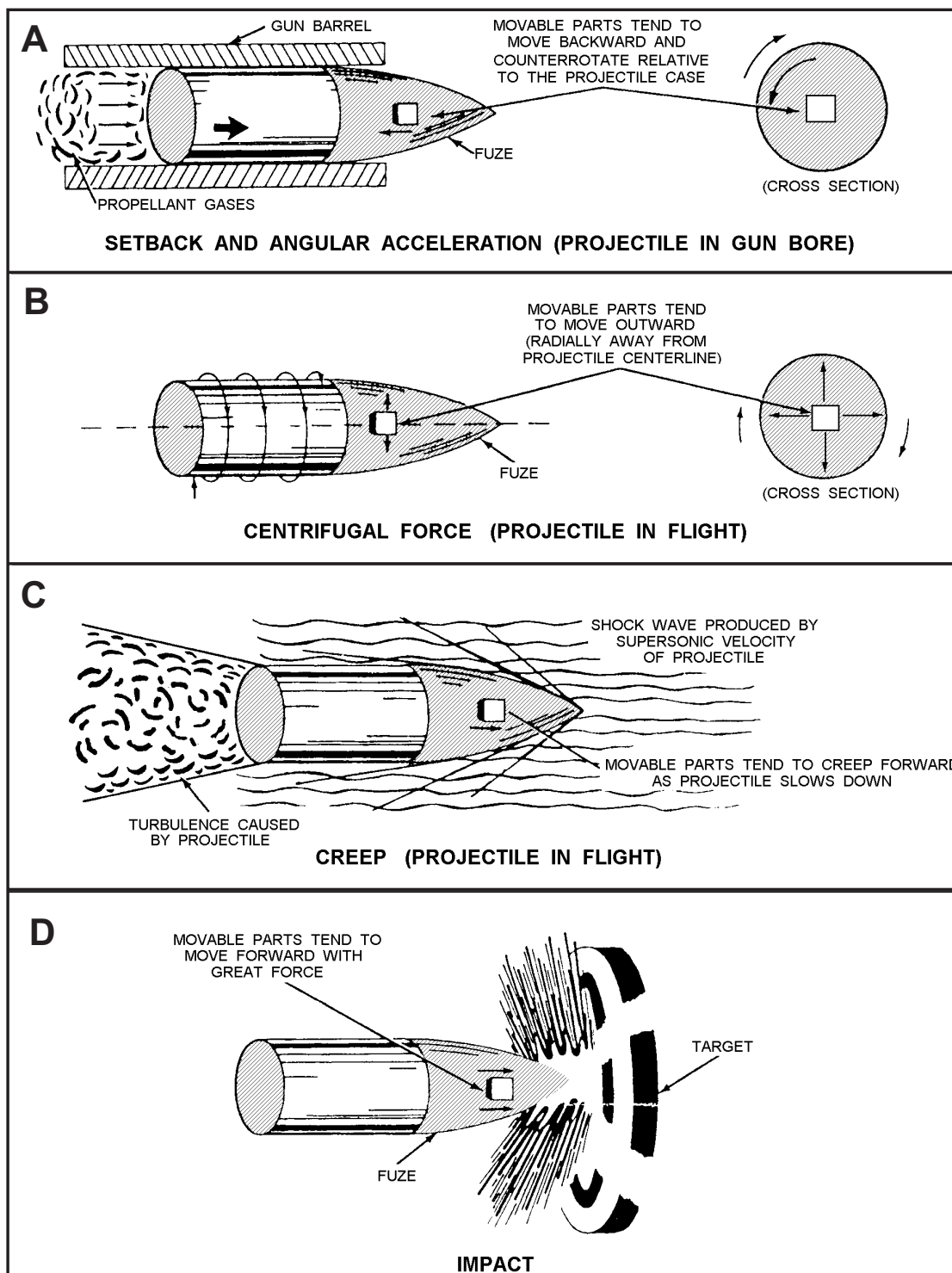
All objects have a property known as inertia. For our purpose we can say that inertia means resistance to change in motion. A moving ship, for example, tends to keep going after the engines have been stopped. It would keep going indefinitely if it were not for the fluid friction of the water and obstacles in its way. By the same reasoning, a ship dead in the water tends to remain so; it takes a mighty effort by its propulsion machinery to get it underway.

In 1687, in a Latin treatise on natural philosophy entitled "Principia," Sir Isaac Newton described this characteristic behavior of material things in the statement of his first law of motion:

"Every body tends to remain at rest, or in uniform motion in a straight line, unless compelled by external force to change."

Why bring up Newton and his laws of motion when we are discussing fuzes? The reason is that every one of the forces that acts on a projectile fuze—from firing to impact—is an effect of inertia.

Let's begin by discussing setback (fig. 2-7, view A). When the propelling charge of the round fires, the fuzes and projectile are at rest. As the hot gases expand,



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Figure 2-7.—Forces that work on fuzes: A. Setback and angular acceleration (projectile in gun bore); B. Centrifugal force (projectile in flight); C. Creep (projectile in flight); D. Impact.

pressure in the chamber builds up and forces the projectile to move forward. But because of inertia, every particle of the projectile and fuze tends to stay where it is. The effect is the same as what you feel while riding in a car when the driver stomps on the gas pedal. Your head snaps back as the car jerks forward. The same thing happens in the projectile and its fuze, except that the acceleration—and the setback effect—are thousands of times greater. As an example of its application to fuzes, setback is used in mechanical time fuzes to unlock the clockwork mechanism.

Angular acceleration (fig. 2-7, view A) produces an inertia force accompanying the initial rotation of the projectile in the bore of the gun. It is similar in effect to setback, which is the resistance to forward motion, in that it resists the rotational motion of the projectile as it passes through the rifled bore.

As the projectile rotating band is twisted by the gun bore's rifling, the projectile spins. You know how spinning develops centrifugal force (fig. 2-7, view B), a tendency to fly directly away from the center of rotation. Centrifugal force is used to operate the clockwork in most mechanical time fuzes. It is also used to assist in readying (arming) the fuze to function when it strikes or approaches the target.

Creep (fig. 2-7, view C) is another effect of inertia. Like anything else that moves through the air, a projectile in flight moves against air resistance, which tends to slow it down. Its supersonic speed creates shock waves and turbulence that increase this frictional slowing. This slowing-down effect is applied to the exterior of the projectile only. The parts inside are not overcoming any air resistance, so they do not tend to slow down. In an automobile, for example, when the brake (simulating air resistance) is being applied lightly, you tend to lean forward. Similarly, movable parts in a fuze tend to creep forward as the projectile plows through the air that slows it down. In many types of fuzes, creep force is used to align the fuze-firing mechanism so that it will function on impact.

Impact (fig. 2-7, view D) is probably the most obvious application of the general principle of inertia to fuzes. When the projectile strikes, it comes to a stop. But the movable parts inside the fuze tend to keep right on going. The force developed by impact is used when you drive a firing pin against a percussion cap to initiate the explosive train. Some people think of impact as a kind of creep—but in a very violent form. In principle, it is true that creep and impact are related, but they are quite different in degree and are used differently in fuze mechanisms. It is best to consider them separately and understand the function of each.

FUZE TYPES AND FUNCTIONING

Fuzes can be classified by functions as follows:

- **Time fuzes:** Mechanical time fuzes (MTFs) function a predetermined length of time after the projectile is fired. The exact time is set before the projectile is loaded into the chamber by a mechanical fuze setter on the mount. This fuse can also be set with a special fuze wrench. The interval between the instant the fuze is set and the instant the projectile is fired is termed *dead time*. No matter when, how, or by what it is set, the timing mechanism of a time fuze will not function until the projectile is fired.

Time fuzes for larger caliber projectiles are driven by springs because the relatively slow rotation of these projectiles does not produce enough centrifugal force to run the clockwork reliably. Older time fuzes (no longer in use) consisted of slow-burning powder trains of adjustable length, rather than clockwork. The powder was ignited by setback that drove a firing pin into a percussion cap.

- **Proximity fuzes:** Proximity or variable time fuzes (VTFs) are energized after the projectile is fired and function when the projectile approaches closely to the target.

- **Percussion fuzes:** Percussion or impact fuzes function either as the projectile strikes the target or after the projectile penetrates. Some fuzes (nondelay type) function immediately on contact with any thin material (for example, the thin sheet metal skin of an aircraft). Fuzes for armor-piercing projectiles, however, always incorporate a slight delay to keep the burster from going off until after penetration. These percussion fuzes can be located either on the nose (PDF) or the base (BDF) of the projectile.

- **Combination fuzes:** Combination fuzes incorporate both time and percussion features; that is, the fuze may go off either on impact or after the time set, whichever occurs first.

- **Auxiliary fuzes:** An auxiliary fuze (ADF), as the name implies, operates only in conjunction with other fuzes. In gun projectiles they form part of the explosive train and pass on the explosion initiated by another fuze (located in the projectile nose) to the main bursting charge.

Proximity fuzes in projectiles are miniature radio transmitters and receivers, powered by tiny battery cells. The cells are activated by setback. When the projectile approaches closely to a target, the radio

waves sent out by a transmitter are reflected back to the receiver in sufficient strength to close a circuit that initiates fuze action.

Most projectile fuzes use a small detonating charge to set off the explosive train. These are called detonating fuzes. Some fuzes, however, are called ignition fuzes because they are designed to produce a flame that will set off an explosive sensitive to flame (usually black powder).

In general, proximity, time, and percussion fuzes are located in the projectile nose. ADFs are located just behind the nose fuze. In AP projectiles (the hardened cap makes no provision for nose fuzes) the fuze is in the base. In some projectiles, to provide greater versatility for selected targets, a nose and a base fuze are provided. The nose fuze can be inactivated at the gun for base fuze initiation. When the nose fuze is activated, the base fuze functions as a backup for greater reliability.

A fuze is intended not only to explode the burster charge at the right time, it is intended to prevent explosion at the wrong time. A fuze is armed when it is made ready to function. Before firing, when it is set not to function, it is considered safe.

Fuzes have safety features to protect those who handle ammunition. These safety features may be nullified by the time the projectile reaches the enemy. Some of the features are canceled by hand or mechanically before the gun is loaded. Others depend

on the forces developed by the actual firing to arm the fuze. Fuzes that are armed only after the projectile leaves the gun muzzle are called boresafe. Projectiles 40-mm and larger are usually boresafe; projectiles 20-mm and smaller generally are not. This is important for you to remember when handling smaller caliber fuzed ammunition.

To illustrate how inertia is used to arm and operate a projectile fuze, let's look at a typical fuze (fig. 2-8). When the gun is fired, the force of setback moves the internal components of the fuze rearward and locks them against movement. As the projectile moves down the rifled bore, it is imparted rotation through the rotating band, creating centrifugal force. The projectile and fuze body travel through the air, meeting resistance and slowing down because of friction. The inertial force of creep frees the internal components for movement. Centrifugal force then moves the two sets of detents outward, unlocking the firing pin and detonator rotor for movement. Centrifugal force, acting on weights in the rotor, causes the rotor to turn until the detonator is in direct alignment between the firing pin and the booster lead-in. Continued centrifugal force maintains the explosive train in alignment. The fuze is armed. Upon impact, the firing pin is driven into the detonator, initiating the explosive train through the explosive lead to the booster charge. The booster charge detonates the main burster charge.

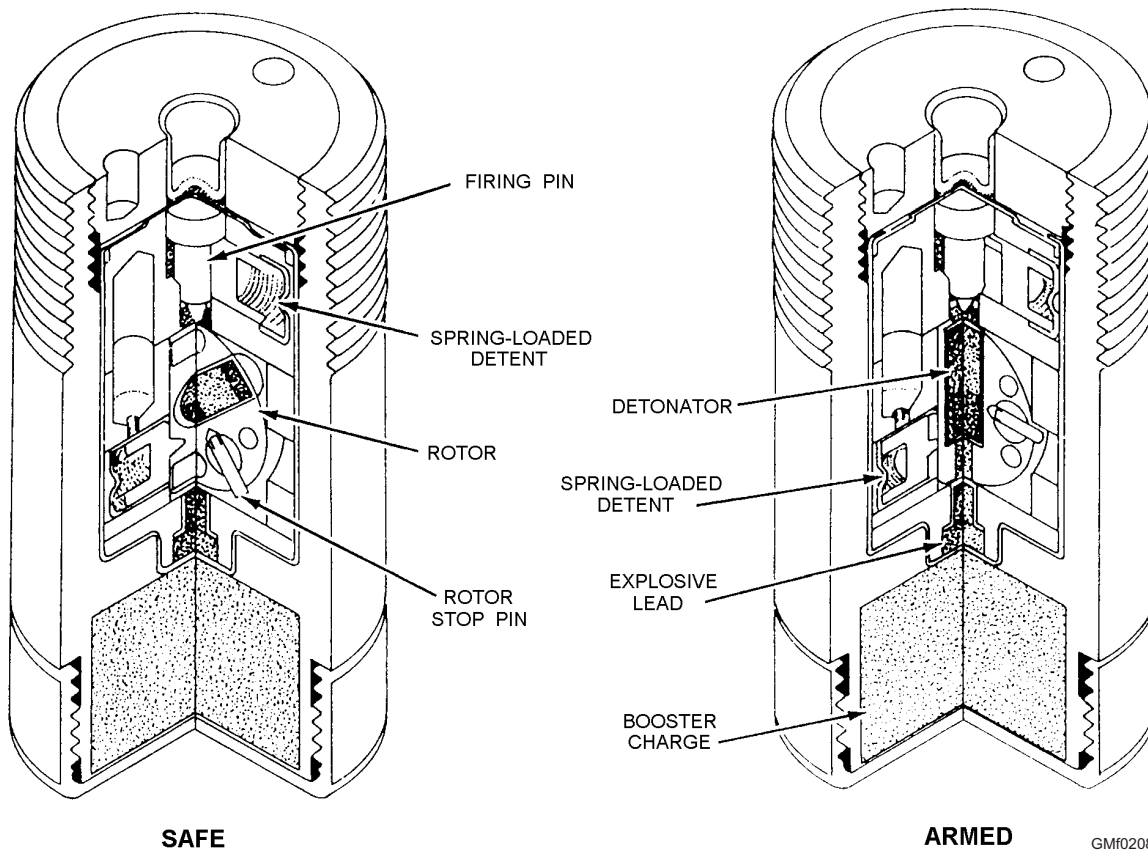


Figure 2-8.—Projectile base fuze.

Many different arrangements are used to arm both gun projectile and missile fuzes. All use the forces of inertia in one way or another. Some are totally mechanical and some are a combination of mechanical and electrical. For further detailed information on fuze arming and operation, see *U.S. Navy Ammunition, Historical and Functional Data*, NAVSEA SW010-AB-GTP-010. More information on gun ammunition, including explosive charges, projectiles, and fuzes, is contained in *Ammunition Afloat*, NAVSEA OP 4, and *Navy Gun Ammunition*, NAVSEA SW030-AA-MMO-010.

IDENTIFICATION OF AMMUNITION

LEARNING OBJECTIVE: Identify and discuss ammunition lot numbering and the ammunition color code system.

A standard nomenclature and numbering system has been established by the Department of Defense (DOD). This system is a four-digit, alphanumeric code that will be either a DOD identification code (DODIC) assigned by the Defense Logistics Services Center (DLSC) or a Navy ammunition logistics code (NALC) assigned by the Ships Parts Control Center (SPCC). Some examples of DODIC/NALC nomenclature are as follows:

AMMUNITION TYPE	DODIC/NALC
5"/54 Illumination Projectile	D328
6"/50 BL&P Projectile	D873
12-gauge OO Buckshot	A011

AMMUNITION LOT NUMBERS

When ammunition is manufactured, an ammunition lot number is assigned according to specifications. As an essential part of the lettering, the lot number is stamped or marked on the item, size permitting, as well as on all packing containers. There are presently two ammunition lot numbering systems in the ammunition inventory. The newest lot numbering system was implemented by the Navy in 1978, so there is much ammunition still identified by the old ammunition lot numbering system. Both of these systems are described in the following paragraphs.

Current Ammunition Lot Numbering System

For all ammunition items and their components, the ammunition lot number consists of a manufacturer's

identification symbol, a numeric code showing the year of production, an alpha code representing the month of production, a lot intermix number followed by a hyphen, a lot sequence number, and, when necessary, an alpha character used as an ammunition lot suffix to denote a reworked lot. The following illustrates the construction of a current ammunition lot number: AMC78D018-124B, where

AMC	=	manufacturer's identification symbol
78	=	a two-digit numeric code identifying the year of production (1978)
D	=	a single alpha code signifying the month of production (April)
018	=	lot intermix number
124	=	lot sequence number
B	=	ammunition lot suffix (the alpha suffix)

Exceptions to the foregoing system for numbering ammunition lots are given in MIL-STD 1168, section 5.

Old Ammunition Lot Numbering System

The old ammunition lot numbering system consists of the ammunition lot number (ALN) symbol, followed by a two- to three-letter prefix, a sequential lot number, a one- to three-letter manufacturer's symbol, a two-numeral group, and, on some, a lot suffix. An example of an ALN is BE-374-HAW-75, where

BE	=	5-inch, 38-caliber AAC projectile
374	=	374 lot of AAC projectiles assembled
HAW	=	NAD Hawthorne assembly activity
75	=	assembled during the year of 1975

Prefix Designation. The two- to three-letter prefix designation identifies the size and type of ammunition item. A prefix designation having a final letter *R* denotes renovated items.

Sequential Lot Number. The one- to four-character group following the prefix indicates the sequential lot number of that particular type produced by an activity during the calendar year. This group consists of numbers 1 through 9999.

Manufacturer's Letters and Numbers. A one- to three-letter group identifies the ordnance activity that assembled the ammunition item.

Year Group. Following the manufacturer's symbols is the final numerical group, indicating the last two digits of the calendar year of assembly.

Lot Suffix. An alpha character, following the year of assembly, usually indicates that some type of special screening was performed.

Grand-Lot Designation. A grand-lot (GL) designation was assigned to serviceable remnant ammunition items of the same type after serviceability evaluation. These remnant lots are consolidated and reissued under a new ammunition lot number having a GL designation. GL ammunition is still in the supply system, but this procedure is no longer used.

COLOR CODES, MARKINGS, AND LETTERINGS

The system of identifying ammunition by the use of color codes, marking, and lettering is intended to be a ready identification to determine the explosive loads

and hazards presented by each. A color coding system is used to indicate the primary use of ammunition, the presence of a hazardous (explosive, flammable, irritant, or toxic) filler, and/or the color of tracers, dye loads, and signals. Current color coding for ammunition of 20-mm and larger is contained in MIL-STD-709, OP 2238 (latest revision), and WS 18782. The lettering, stenciled or stamped on ammunition, includes all the information necessary for complete identification and is marked in compliance with NATO standards and Department of Transportation (DOT) regulations. In addition to standard nomenclature and lot numbers, lettering may include such information as the mark and mod, the type of fuze, and the weapon in which the item is fired. Table 2-1 gives the meaning of the different color codes.

Table 2-1.—Ammunition Color Coding

COLOR	INTERPRETATION
Yellow	<ol style="list-style-type: none"> Identifies high explosives. Indicates the presence of explosives, either, <ol style="list-style-type: none"> sufficient to cause the ammunition to function as a high explosive, or, particularly hazardous to the user.
Brown	<ol style="list-style-type: none"> Identifies rocket motors. Indicates the presence of explosive, either, <ol style="list-style-type: none"> sufficient to cause the ammunition to function as a low explosive, or, particularly hazardous to the user.
Gray	Identifies ammunition that contains irritant or toxic agents when used as an overall body color except for underwater ordnance.
Gray With Red Band(s)	Indicates the ammunition contains an irritant (harassing) agent.
Gray With Dark Green Band(s)	Indicates the ammunition contains a toxic agent.
Black	Identifies armor-defeating ammunition, except on underwater ordnance.
Silver/ Aluminum	Identifies countermeasures ammunition.
Light Green	Identifies smoke or marker ammunition.
Light Red	Identifies incendiary ammunition or indicates the presence of highly flammable material.
White	Identifies illuminating ammunition or ammunition producing a colored light; exceptions, underwater ordnance, guided missiles, and rocket motors.
Light Blue	Identifies ammunition used for training or firing practice.
Orange	Identifies ammunition used for tracking or recovery.
Bronze	Identifies dummy/drill/inert ammunition used for handling and loading training.
Nonsignificant Colors	
Olive Drab	All ammunition items.
Black	For lettering.
White	<ol style="list-style-type: none"> For lettering. For guided missiles and rocket motors.

RETAIL ORDNANCE LOGISTICS MANAGEMENT SYSTEM

LEARNING OBJECTIVE: State the capabilities of the Retail Ordnance Logistics Management System (ROLMS)

The Retail Ordnance Logistics Management System (ROLMS) is an integrated system of applications software designed to manage non-nuclear expendable ordnance. It provides for the automation of the receipt, issue, inventory record keeping, and reporting of ammunition assets and movements with the ultimate objective being the enhancement of Fleet readiness and stock point ordnance management. ROLMS replaced four legacy systems, Ordnance Management System (OMS), Fleet Optical Scanning Ammunition Marking System (FOSAMS), the Standardized Conventional Ammunition Automated Inventory Record (SCAAIR) and the Ammunition Logistics System (AMMOLOGS).

ROLMS was designed to operate as either a stand alone system residing on a personal computer or in a client/server network environment.

ROLMS Capabilities

ROLMS supports all ship and shore activity asset management and reporting requirements. ROLMS automates many ammunition logistics management and reporting functions performed by the stock points and end users, specifically:

- a. Inventory – to the specific grid location
- b. Requisitioning
- c. Issue/Receipt Reporting
- d. Expenditure Reporting
- e. Asset Maintenance
- f. NAR processing
- g. Transaction reporting (either Ammunition Transaction Reporting (ATR) or Transaction Item Reporting (TIR))
- h. Space Management – including Net Explosive Weight (NEW) Management for Explosive Arc and Compatibility Management
- i. Load Plan management

- j. Excess/Disposal Processing
- k. DD 1348-1's and shipping labels
- l. Bar Code processing

ROLMS System Interfaces

ROLMS interfaces with various systems to exchange data and information. Specifically:

- a. CAIMS for Navy and Marine aviation ordnance inventory data.
- b. MAARS-II for Marine Corps ground ordnance inventory data.
- c. ADIMS for ordnance held for disposal and demilitarization.
- d. Total Ammunition Movement Management System (TAMMS) for internal activity transportation.
- e. Defense Transportation Tracking System (DTTS) for ordnance transportation satellite tracking.
- f. Marine Air Ground Task Force (MAGTF) Deployment Support System II (MADSS-II) for ground ammunition movement tracking.

For further information on the ROLMS system, refer to NAVSUP P-724, Chap 9.

CONVENTIONAL AMMUNITION INTEGRATED MANAGEMENT SYSTEM

LEARNING OBJECTIVES: Demonstrate and discuss ammunition, administration, and the inventory management (CAIMS) procedures.

The maintenance of an accurate inventory of all explosive ordnance held by a fleet unit is the primary concern of everyone involved. The current CNO requirement is that units maintain a 99.5 percent inventory accuracy rate. Foundational to this is the maintenance of the onboard ammunition stock record, commonly referred to as the "ammunition ledger" or just "the ledger." As ammunition is received, expended, or transferred, the ledger is updated to reflect the change. These changes are then reported to the SPCC,

CAIMS is designed to be a management tool for all levels of the Navy that are concerned with inventory management. The *CAIMS Manual*, SPCCINST 8010.12, describes the system in detail and the procedures to be used by each type of activity in maintaining and reporting ammunition inventory information. In the following sections, we expand on

AMMUNITION STOCK RECORD

The ammunition stock record (or ledger) is a fleet unit's master record of all ammunition stocks held, as well as a record of past transactions and inventories held. The ledger consists of a master stock record card (MSRC) for each NALC or DODIC held by the unit and an ammunition lot or serial/location card for each different lot or serial number.

Master Stock Record Card

The MSRC (fig. 2-9) serves as a record of the total number of rounds of a certain NALC/DODIC held by the unit in each condition code. The MSRC is also used to record information identifying each transaction and the total quantity of ammunition ordered, received, transferred, or expended.

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Figure 2-9.—Ammunition master stock record card.

Ammunition Lot/Location Card

The ammunition lot/location card (fig. 2-10) is used to record the quantity and stowage location of an individual lot of ammunition. Transaction information is also recorded on this card but only for transactions concerning the lot listed.

Ammunition Serial/Location Card

The ammunition serial/location card (fig. 2-11) is used to account for serialized items such as missiles and torpedoes. Each card accounts for one item. In addition to maintaining an accurate inventory, these cards are used to record the maintenance-due date of the item covered. The maintenance-due date indicates the date the item must be turned in to a weapons facility for inspection and any required maintenance.

Your ammunition ledger will most likely contain all three of these record cards. You will have one MSRC for each NALC and DODIC carried. These will be arranged in NALC/DODIC alphanumeric order in a binder or cabinet. Under each MSRC is an ammunition lot or serial number location card for each lot or serial-numbered item carried of that NALC/DODIC. As ammunition is ordered, received, transferred, or

expended, it is recorded on the cards. First, the total number of rounds involved is entered on the MSRC for that particular NALC/DODIC. The total number is then broken down by lot or serial number, and each different number is entered on the appropriate location card. All entries are to be made in ink or typed. These cards are required to be retained for a minimum of 1 year after the item is expended or transferred.

The cards in the ammunition ledger contain much more information than what has been presented here. Chapter 12 of SPCCINST 8010.12 provides detailed guidance on the makeup and maintenance of the ammunition ledger.

AMMUNITION TRANSACTION REPORTS (ATRs)

Each time a piece of ammunition is expended, transferred, received, or changes condition code, an ammunition transaction report (ATR) must be submitted to update CAIMS. This is normally required to be done within 24 hours of the event. ATRs are sent by naval message according to the instructions listed in SPCCINST 8010.12, chapter 8. A copy of each ATR message is maintained in a file and kept with the ledger. The ledger and the ATR file must match 100 percent.

AMMUNITION LOT/LOCATION CARD											
NAVSUP FORM 1297 (REV. 8-87)								S/N 0108-LF-501-2971			
ENTRY DATE	DOCUMENT NUMBER			TRANSACTIONS		ON-HAND BALANCES				CONSIGNOR CONSIGNEE	REMARKS
	ACTIVITY	DATE	SERIAL	TYPE	QUANTITY	COND.	COND.	COND.	COND.		
PACKAGING - REMARKS											NEW
LOGISTICS CODE		NIIN/NOMENCLATURE				LOT NO.		STOWAGE LOCATION		C.G. HAZ CL.	

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Figure 2-10.—Ammunition lot/location card.

[illegible]

Figure 2-11.—Ammunition serial/location card.

AMMUNITION REQUISITIONS

Fleet units requisition all nonnuclear ordnance using the Military Standard Requisitioning and Issuing Procedures (MILSTRIP) format in a naval message. MILSTRIP relies upon coded data for processing requisitions by means of automatic data processing equipment. Each ship is provided with an ammunition allowance list of one form or another, depending on its status/mission. The ship-fill allowance list is the one you will be primarily concerned with. It lists the ammunition types and quantities authorized for issue in support of that ship's mission. This list includes the training allowance. All ammunition requisitions must be made with the allowance list in mind. Training allowance increases may be requested.

At this writing, ammunition recording, requisitioning, and reporting are in the process of being automated throughout the fleet. The ordnance manager will maintain his or her ledger and generate requisitions and ATRs all from the same computer terminal. The format, however, will remain the same.

There are many requirements and special instructions involved in the preparation of an ammunition requisition. The mechanics of requisitioning ammuni-

tion are well beyond the scope of this manual. Refer to chapter 8 of SPCCINST 8010.12 for detailed information concerning ammunition MILSTRIP requisitions. Your supply officer and the ship's Storekeepers (SKs) are also excellent sources of expertise concerning requisitions.

SHIPBOARD AMMUNITION INSPECTION

LEARNING OBJECTIVES: Describe the requirements, procedures, and information sources governing magazine and ammunition inspections, inventories, requisitions, and inventory control.

During the late 1960s and early 1970s, the U.S. Navy experienced several catastrophic explosions on its ships. As a result of ensuing investigations, several pertinent facts were disclosed. It was determined that an apparent lack of understanding existed regarding the inspection of ammunition. Gunnery personnel were not familiar with the principle of the gas-check system in the base of projectiles or were not familiar with the gun ammunition lot number system and the notice of ammunition reclassification (NAR) in

TWO24-AA-ORD-010. Results of the investigation indicated that increased understanding was required.

From the foregoing it can be seen that all GMGs 3 and 2 should make every effort to increase their knowledge of gun-type ammunition by seeking out and studying all available OPs, ODs, and instructions. Gaining this knowledge is not only beneficial to you in self-satisfaction but in knowing the proper procedures in the care and handling of ammunition and the steps to be taken in emergencies.

An important point to remember is that ammunition in any form is dangerous unless it is properly tended. Any deviation from authorized procedures can lead to problems. Minor unauthorized acts can establish a train of events that can eventually cause a magazine to blow. Therefore, it is imperative that ordnance personnel follow standard operating procedures exactly; if any doubt exists, contact the nearest ammunition facility for guidance.

NAVSEA has directed the mandatory inspection of 5-inch, high-explosive-loaded projectiles with gas-check seals (GCSs) before issue by NAVSEA activities or an overseas ammunition issuing activity. Gun projectiles fitted with a base fuze or base plug are equipped with a GCS to prevent hot propellant gases from penetrating into the explosive cavity of the projectile body. This GCS inspection by experienced ammunition personnel includes sighting that (1) the GCS is not missing, (2) the GCS is symmetrical and properly seated, (3) it is not cracked, cut or torn, and (4) the BDF or base fuze hole plug (BFHP) is flush or slightly below the projectile base. After inspection, issuing activities ashore certify a good GCS by applying a suffix, either A or B, according to TWO24-AA-ORD-010 as appropriate, on the projectile and the data card.

To safeguard against damage during subsequent handling and the possibility of sabotage, the firing ship should, before use, examine each 5-inch high explosive loaded projectile for proper GCS. A complete description of GCS inspection procedures is provided in the *Navy Gun Ammunition*, NAVSEA SW030-AA-MMO-010. Ordnance personnel should also check ammunition to see that (1) waterproof protecting caps are properly installed, (2) nose fuzes are properly seated and not loose, (3) upper nose caps of fuzes are intact, and (4) complete rounds can be identified by lot identification number. This system of identification is simple, but it requires study to understand and must be followed to be effective.

MAGAZINES

LEARNING OBJECTIVES: Recall the types, designations, security measures, and inspection criteria for shipboard magazines.

The term *magazine* applies to any compartment, space, or locker that is used, or intended to be used, for the stowage of explosives or ammunition of any kind.

The term *magazine area* includes the compartment, spaces, or passages on board ship containing magazine entrances that are intended to be used for the handling and passing of ammunition. The term is also used to denote areas adjacent to, or surrounding, explosive stowages, including loaded ammunition lighters, trucks, and railroad cars, where applicable safety measures are required.

Magazines are arranged with regard to facility of supply, the best obtainable protection, and the most favorable stowage conditions.

MAGAZINE TYPES

There are many different types of magazines provided on ships. Each magazine is designed specifically for the type of ammunition it is to contain. For our purpose, however, we will be concerned with only three types—primary magazines, ready-service magazines, and ready-service stowage.

Primary Magazines

Primary magazines are designed as ammunition stowage spaces, generally located below the main deck, and insofar as is practical, below the waterline. They are adequately equipped with insulation, ventilation, and sprinkler systems. These spaces must be provided with fittings so that they may be locked securely. Primary magazines accommodate a vessel's complete allowance of ammunition for peacetime operation.

Ready-Service Magazines

Ready-service magazines are spaces physically convenient to the weapons they serve. They provide permanent stowage for part of the ammunition allowance. Normally they are equipped with insulation, ventilation, and ammunition sprinkler systems, and should be secured by locking. The combined capacities of primary and ready-service magazines are normally sufficient to properly stow the ship's allowance for war and emergencies.

Ready-Service Stowage

Ready-service stowages are those ammunition stowage facilities in the immediate vicinity of the weapon served. They include weather deck lockers, bulwark (gun shield) racks, and 5-inch upper handling rooms. This stowage normally is filled only when the weapon is to be fired. There is little security for ammunition in such stowage, and it provides the least favorable protection from the elements.

All magazines are marked by appropriate label plates showing the compartment number and the types of ammunition to be stowed therein. Insofar as is practical, magazines are designed to hold a single type of ammunition.

MAGAZINE DESIGNATIONS

The following designations are given for magazines whenever a single-purpose stowage is practical:

- Powder magazines
- Fixed-ammunition magazines
- Small arms magazines
- Warhead lockers
- Projectile magazines or rooms
- Bomb magazines
- Missile magazines
- Fuze magazines
- Detonator lockers
- Pyrotechnic magazines or lockers

While stowage of a single type of ammunition in individual magazines is desirable, it is not always possible due to space limitations. Where a ship's mission requires carrying various types of ammunition, stowage of more than one type in one magazine is acceptable. Current NAVSEASYSCOM instructions authorize certain mixed stowage in magazines that maintain a single-purpose designation.

Authorization of mixed stowage is at the discretion of the operational commander. Such stowage does not include pyrotechnics that have been removed from containers, or fuzes and detonators that are not integral parts of, or assembled within, the ammunition. These items must be stowed according to the current instructions related to the particular items.

Where mixed stowage of ammunition is necessary, precautions should be taken to make sure the various types of ammunition are segregated within the magazine and each type is suitably marked for ready identification. All specific questions concerning stowage requirements should be referred to *Ammunition Afloat*, NAVSEA OP-4.

MAGAZINE SECURITY

In peacetime, all magazines, explosive lockers, ready-service lockers, and all areas such as ammunition hoists leading into magazine spaces are kept closed and locked, except when they are opened for inspection, for ventilating purposes, for testing, or for authorized work. These spaces are not entered unnecessarily and are opened only when authorized by the weapons officer. The weapons officer is responsible for making sure that the spaces are locked when the purpose for which it was opened has been accomplished.

Magazines are intended for the stowage of ammunition and for this only. A magazine is no place for the stowage of empty paint or grease cans, oily waste rags, or similar fire hazards. What goes for material also goes for personnel. No one but those authorized should ever be permitted in a magazine. Even they should be there only when they have business there. A magazine is no place to sit around and "shoot the breeze."

The commanding officer (CO) is the custodian of all magazine keys. The CO may, however, designate certain persons under his or her command to have custody of duplicate keys. Each morning keys are drawn by a responsible Gunner's Mate for the purpose of inspecting magazines and taking magazine temperatures.

SECURITY OF NUCLEAR WEAPONS MAGAZINES

With the rapidly changing world political picture, nuclear weapons have begun to be considered as less of a necessary component of the U.S. ready arsenal. At this writing, the President has ordered the removal of most nuclear weapons from U.S. surface ships. Therefore, we will provide only a brief description of the security requirements and procedures pertaining to surface ship nuclear weapons.

Nuclear weapons, because of their strategic importance, public safety considerations, and political implications, require greater protection than their security classification alone would warrant. The special

shipboard installations required for the safety and security of these weapons vary with the type of ship and weapon involved. As a GMG, your association with nuclear weapons will be limited. However, it is possible that because you are in the Gunner's Mate rating, you might be called upon to take part in a ship's safety and security program for nuclear weapons.

The following discussion provides a basis for determining the minimum security requirements for nuclear weapon spaces. The definitions that follow are those used throughout the Navy in connection with nuclear weapons:

- **Access:** Applied to nuclear weapons, physical access that permits the opportunity to cause a nuclear detonation.
- **Exclusion area:** A security area that contains one or more nuclear weapons or one or more components of a nuclear weapon system. The nature of the area is such that mere entry constitutes access to the nuclear weapon or permits the arming, launching, or firing of a weapon.
- **Controlled area:** A security area that surrounds an exclusion area. Aboard ship, this area includes the entire ship when nuclear weapons are on board. When on-loading or off-loading nuclear weapons alongside a pier, the controlled area is extended to the pier.
- **Nuclear weapon:** Any complete assembly of its intended ultimate configuration that, upon completion of the prescribed arming, fuzing, and firing sequence, is capable of producing the intended nuclear reaction and release of energy.

Safety and security are considered to be synonymous when it comes to nuclear weapons. The main objective is to prevent an inadvertent or deliberate nuclear accident or incident. The standards governing the installation of safety equipment and facilities for protecting the nuclear weapons must be according to the criteria set forth in current NAVSEA and OPNAV instructions.

INSPECTION OF MAGAZINES

The periodic (daily, weekly, monthly, bimonthly, quarterly, semiannual, or annual) inspections of magazines and their contents should be conducted aboard ship and ashore according to instructions contained in applicable publications and 3-M Systems requirements. The primary source of magazine inspection criterion is the appropriate 3-M Systems maintenance requirement cards (MRCs). These

procedures are derived from the standards listed in other source publications such as *Ammunition Afloat*, NAVSEA OP-4.

Magazine Temperatures

The main purpose of a daily magazine inspection is to check and record space temperatures. If you recall, temperature is the single most important factor that affects powder and propellant stability.

Temperature readings normally are taken once a day. The exact time may vary, but most ships take the readings in the morning (around 0800 for example). A special maximum and minimum thermometer is used. (Sometimes it's called a high-low thermometer.) Figure 2-12 illustrates a typical maximum and minimum thermometer.

Every magazine or locker will have at least one such direct-reading thermometer. It will be located where maximum space temperature variations will normally occur. It must be installed so it is readily accessible for taking readings and resetting the index pointers. Special brackets are available to mount the thermometer where accidental damage can be averted.

View A of figure 2-12 shows the internal components of the device. The temperature-sensitive

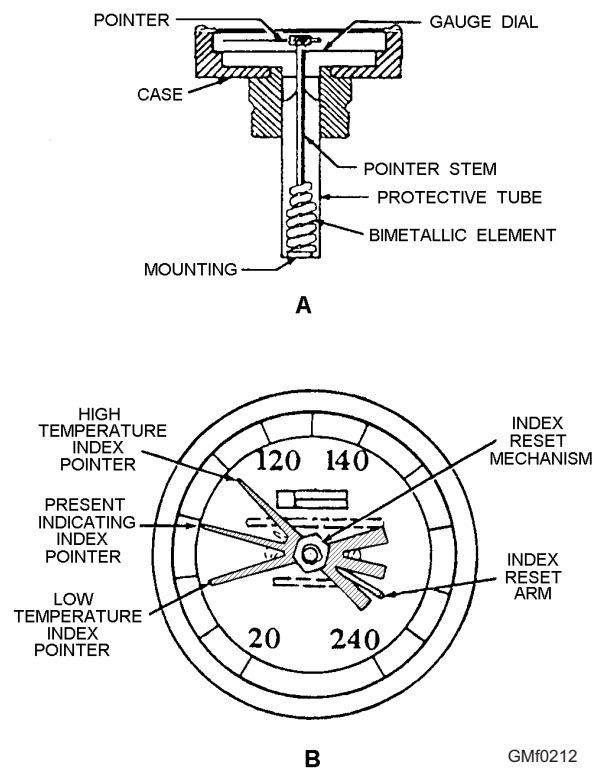


Figure 2-12.—Bimetallic maximum and minimum thermometer: A. Internal components; B. Dial face and pointers.

The 45-degree spread between the high and low pointers in our example is a bit large, but illustrated for clarity in our explanation. However, it could happen. The reading you must be cautious about is the 100EF

The bimetallic maximum and minimum thermometer described is becoming the standard thermometer in shipboard magazines. You may come across a different model. It only has a maximum (high) index pointer and a reset knob. This type of thermometer is acceptable. The older liquid-in-glass (tube) mercury high-low thermometer is no longer authorized for shipboard use. These mercury units should be replaced with the bimetallic-type thermometer.

Written records must be kept of all maintenance operations, whether they are routine or not. As far as magazine inspections and ammunition surveillance are concerned, the most common written record is the daily magazine temperature report form (fig. 2-13) and magazine temperature record. 3-M Systems records

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may also be considered as records of magazine inspection.

The magazine temperature record is a card posted in each magazine. Every day you enter the maximum and minimum temperatures recorded for the previous 24 hours in that magazine. The card is replaced every month, and the old one is turned over to the weapons officer.

The daily magazine temperature report summarizes the results of magazine inspections for the whole ship. This form includes not only spaces for entering the highest and lowest magazine temperatures, but also for reporting the condition of the magazines and their ventilating devices, and (under Remarks) for miscellaneous nondaily routine work.

The daily magazine temperatures are transferred from the record cards to a magazine log that is a permanent record of all magazine temperatures. A separate section of the magazine log should be set aside to record the results of the monthly sprinkler system tests.

Magazines are considered to be in satisfactory condition if inspection shows the space meets the requirements listed on applicable MRCs. Daily inspection requirements usually include checking the general condition and cleanliness of the space. Less frequent inspections (monthly, quarterly, and so on.) normally direct a more detailed check of specific magazine conditions and equipment. Each 3-M inspection requirement should be completely understood and followed to the letter. Doing so not only ensures a safe ammunition storage area but also fulfills the requirements of periodic inspections, such as the explosive safety inspection (ESI). ESI inspectors use the same inspection criteria as are found on your MRCs.

MAGAZINE SPRINKLER SYSTEM

LEARNING OBJECTIVES: Describe the purpose, components and functioning of shipboard magazine sprinkler systems. Identify the various control valves, gauges, and alarm systems.

Sprinkler systems are used for emergency cooling and fire fighting in magazines, ready-service rooms, ammunition- and missile-handling areas. A magazine sprinkler system consists of a network of pipes secured to the overhead and connected by a sprinkler system control valve to the ship's saltwater firemain. The pipes are fitted with sprinkler head valves that are arranged so

that the water forced through them showers all parts of the magazine or ammunition- and missile-handling areas. A modern sprinkler system can wet down all exposed bulkheads at the rate of 2 gallons per minute per square foot and can sprinkle the deck area at the rate of 4 gallons per minute per square foot. Magazine sprinkler systems are designed to completely flood their designated spaces within an hour. To prevent unnecessary flooding of adjacent areas, all compartments equipped with sprinkler systems are watertight. Upper deck-handling and ready-service rooms are equipped with drains that limit the maximum water level to a few inches. Magazines are completely enclosed; if flooded, they would be exposed to the full firemain pressure. The firemain pressure on most ships is considerably higher than the pressure magazine bulkheads could withstand; therefore, magazines are equipped with exhaust ventilators located in the bulkhead near the overhead. An exhaust ventilator is a pipe with a check valve that permits pressure release (usually to topside). Since the diameter of the pipe is large enough to allow water to flow out as fast as it flows in, no excess pressure can build up in the magazine compartment.

On newer ships, magazines are also equipped with small, capped drainpipes located in the bulkhead near the deck. The caps may be removed in the adjacent compartment to drain flooded magazines.

In their complexity, the sprinkler system control valve and associated components vary with the type of ammunition intended for stowage in the magazine.

There are two basic types of hydraulically controlled saltwater/seawater-operated sprinkler systems—the dry type and the wet type. Both types may be found on the same ship. However, the dry type is normally installed in gun ammunition magazines and the wet type installed in missile magazines. For this reason, only the dry type is covered in this chapter. Technical information on both types is contained in *Magazine Sprinkler System*, NAVSEA S9522-AA-HBK-010.

The remaining coverage of the sprinkler system is presented as follows:

- Magazine sprinkler control valves (commonly referred to as main valves)
- Hydraulic (saltwater/seawater) control systems
- Automatic (thermopneumatic) control systems
- Sprinkler alarm systems

MAGAZINE SPRINKLER CONTROL VALVES

Magazine sprinkler valves are normally closed, globe-type valves that are designed to open wide upon actuation and supply seawater to the sprinkler system. They are diaphragm operated and manufactured by either the CLA-VAL or Bailey Company. Both valves open on a minimum operating pressure of 40 psi. Each of these valves is held closed by the combined force of the valve spring and the firemain pressure acting on top of the valve disk.

The diaphragm-operated control valve (fig. 2-14) is held closed by firemain pressure acting against the valve disk and the valve spring force acting against the upper diaphragm washer. When the control system is actuated, seawater from the firemain (operating

pressure) enters the diaphragm chamber and acts against the lower diaphragm washer. The area of the lower diaphragm washer is larger than the area of the valve disk. Accordingly, the magnitude of the resultant upward force is sufficient to overcome the downward forces of the valve spring and the firemain pressure acting against the valve disk. When the control system is secured, the operating pressure is bled from the diaphragm chamber and the valve is closed by the force of the valve spring.

NOTE

The test fittings or test casting for the Bailey and CLA-VAL models are **NOT** interchangeable.

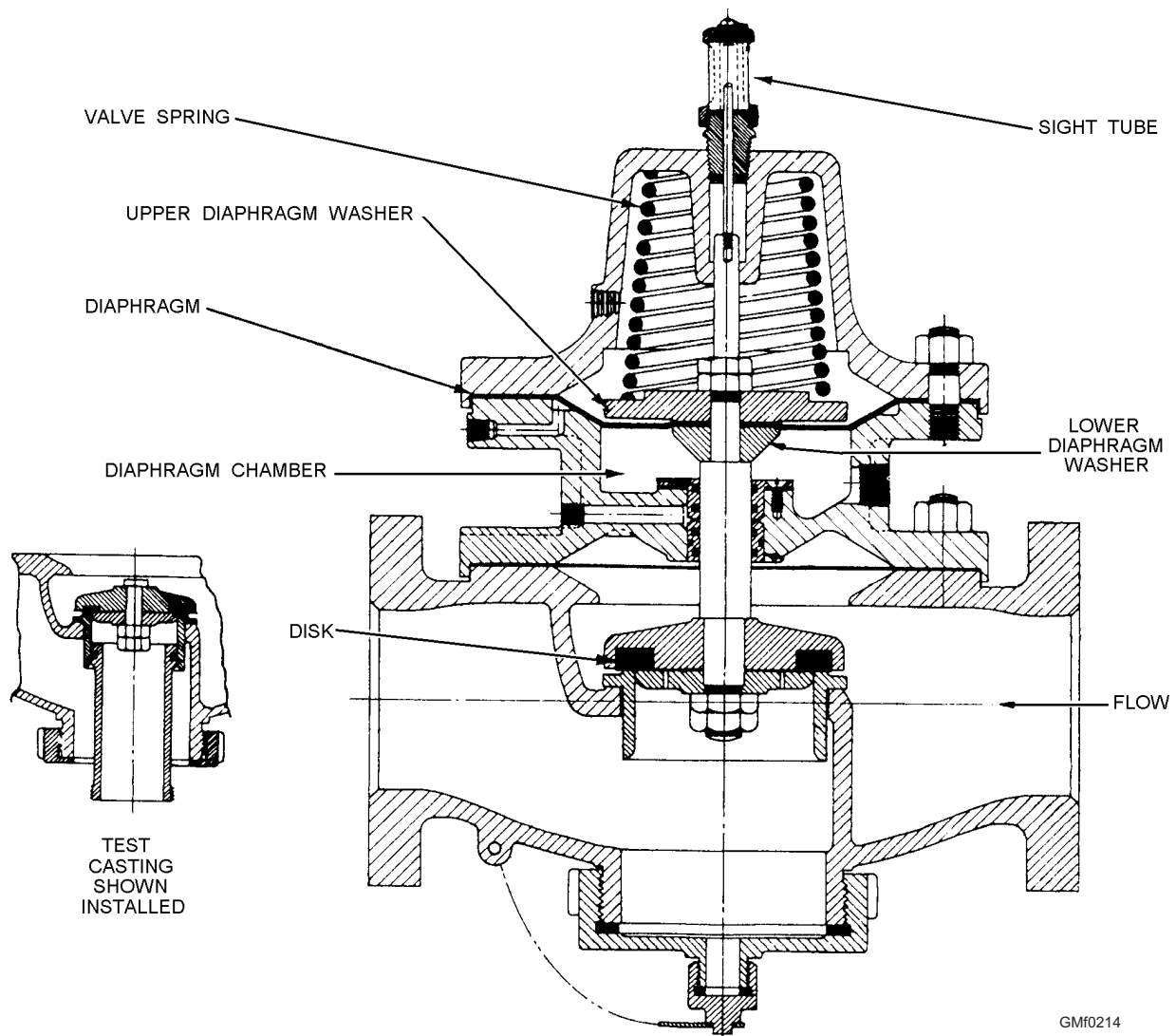


Figure 2-14.—Diaphragm-operated magazine sprinkler control valve.

HYDRAULIC CONTROL SYSTEM

The hydraulic control system is installed to permit rapid actuation of the dry-type magazine sprinkler system. It uses seawater from the firemain for the operating pressure to actuate or secure the magazine sprinkler system.

The hydraulic control system (which is better known as the operating pressure circuit) consists of the control system piping, manual control valve, hydraulically operated remote control valve, spring-loaded lift check valves, and a hydraulically operated check valve (normally used with the diaphragm-operated magazine sprinkler valve) or a power-operated check valve (normally used with the piston-operated magazine sprinkler valve).

Operating Pressure Circuit (Control System Piping)

The operating pressure circuit connects the manual control valves, the hydraulically operated components of the control system, and the magazine sprinkler valve. The operating pressure circuit is divided into an open and a close loop. The open loop transmits operating pressure from the open port of the manual control valve(s) to the operating chamber of the magazine sprinkler valve and the inlet of the hydraulically

operated check valve via the hydraulically operated remote control valve. The close loop transmits operating pressure from the close port of the manual control valve(s) to the operating pressure connections of the hydraulically operated remote control valve and the hydraulically operated check valve.

Manual Control Valves

The manual control valve is a rotary disk plate-type valve that is installed to permit rapid hydraulic operation of the magazine sprinkler valve. Most systems allow manual sprinkler activation and securing from either a local operating station or a remote station. This application uses the three-way, three-position manual control valve (fig. 2-15). Applications that do not incorporate a remote manual control station or an automatic control feature use a three-way, two-position manual control valve.

A locking device, in the form of a key, is installed in the control valve handle to prevent accidental operation of the sprinkler system. The locking key is secured to the handle with a single strand lead wire seal and fastened to the valve cover by means of a safety chain.

Hydraulically Operated Remote Control Valve

The hydraulically operated remote control valve (fig. 2-16) is a diaphragm-operated, globe-type valve

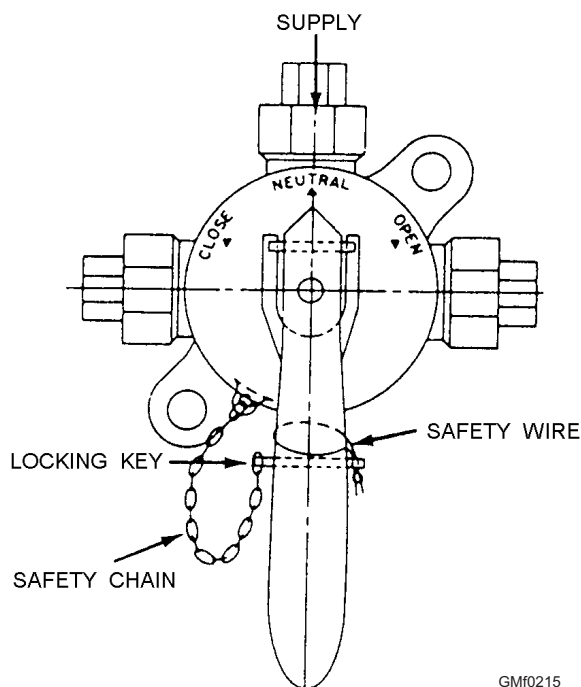


Figure 2-15.—Manual control valve.

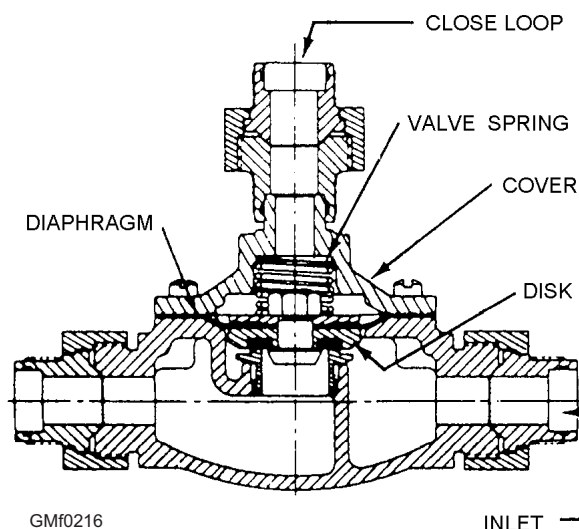


Figure 2-16.—Hydraulically operated remote control valve.

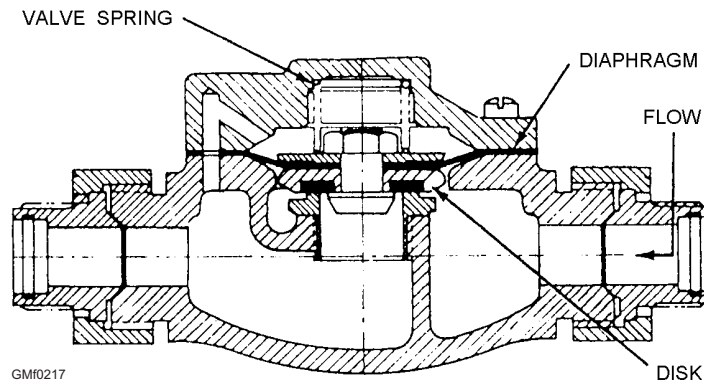


Figure 2-17.—Spring-loaded lift check valve.

that is opened by operating pressure acting against the underside of the disk and closed by operating pressure acting on the top of the diaphragm. The purpose of this valve is to permit the magazine sprinkler valve to be secured from an operating station other than the one from which it was actuated. Additionally, this valve permits the magazine sprinkler valve to be secured from any control station when it has been actuated automatically.

Spring-Loaded Lift Check Valves

This valve (fig. 2-17) is a spring-loaded, diaphragm-operated lift check valve that closes tightly against reverse flow and opens wide to permit flow in the normal direction. Spring-loaded lift check valves

permit the control system to be operated from more than one control station by preventing backflow through the other stations.

Hydraulically Operated Check Valves

The hydraulically operated check valve (fig. 2-18) is a normally closed, diaphragm-operated, globe-type check valve that is opened by operating pressure in the close loop acting against the underside of the diaphragm. This valve permits the operating pressure to be vented from the diaphragm chamber of the magazine sprinkler valve, thereby permitting that valve to close rapidly and completely. This valve is normally installed in conjunction with the diaphragm-operated magazine sprinkler valve.

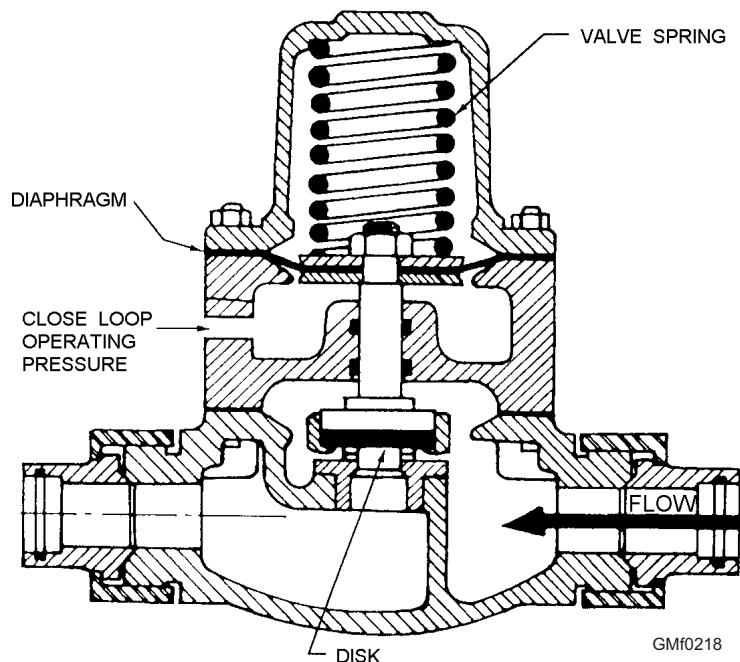


Figure 2-18.—Hydraulically operated check valve.

Power-Operated Check Valves

The power-operated check valve (fig. 2-19) is a normally closed, piston-operated, poppet-type valve that is opened by operating pressure from the close loop of the operating pressure circuit acting against the piston. When the valve opens, the operating pressure is released from the piston of the magazine sprinkler valve, thereby permitting the valve to close completely. This valve is normally installed in conjunction with the piston-operated magazine sprinkler valve.

Orifices

There are two 0.098-inch orifices installed in the control system piping. The primary purpose of the orifices is to prevent a buildup of pressure in the control system piping as a result of leakage past a control system component. Additionally, the orifices serve to vent the operating pressure from the control system piping when the manual control valve is returned to the NEUTRAL position. Orifice No. 1 is installed in the open loop upstream from the hydraulically operated check valve. Orifice No. 2 is installed in the close loop adjacent to the operating pressure connection of the hydraulically operated check valve. When the control system is actuated, there will be a steady flow of water from orifice/drain line No. 1 and no flow from orifice/drain line No. 2. When the control system is secured, there will be a steady flow of water from orifice/drain line No. 2 and a diminishing flow from

orifice/drain line No. 1. When the manual control valve is returned to the NEUTRAL position, the operating pressure is vented from the close loop via orifice/drain line No. 2, thereby permitting the hydraulically operated check valve to close.

The orifices and valves of the hydraulic control system described in this section are illustrated in figure 2-20 by symbols. Pay particular note to the legend list for the symbols. In addition to the orifices and valves, this figure also identifies the open and close loops of the operating pressure circuit.

AUTOMATIC (THERMOPNEUMATIC) CONTROL SYSTEM

Most gun magazine sprinkler systems are equipped with an automatic control system. This control system is designed to actuate the magazine sprinkler system in response to either a rapid rate of rise in temperature or a slow rise to a fixed temperature. The thermopneumatic elements, which monitor the temperature of the magazine and activate the sprinkler system, generate a pneumatic signal in response to thermal action. The pneumatic signal can be either a sudden increase or decrease in air pressure.

The automatic control system consists of heat-sensing devices (HSDs), transmission lines (rockbestos or rockhide-covered copper tubing), circle seal check valves, and a pneumatically released pilot (PRP) valve.

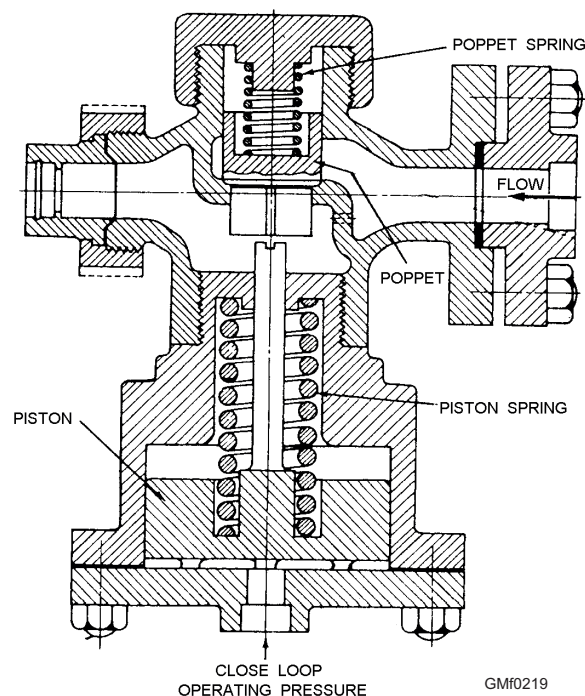


Figure 2-19.—Power-operated check valve.

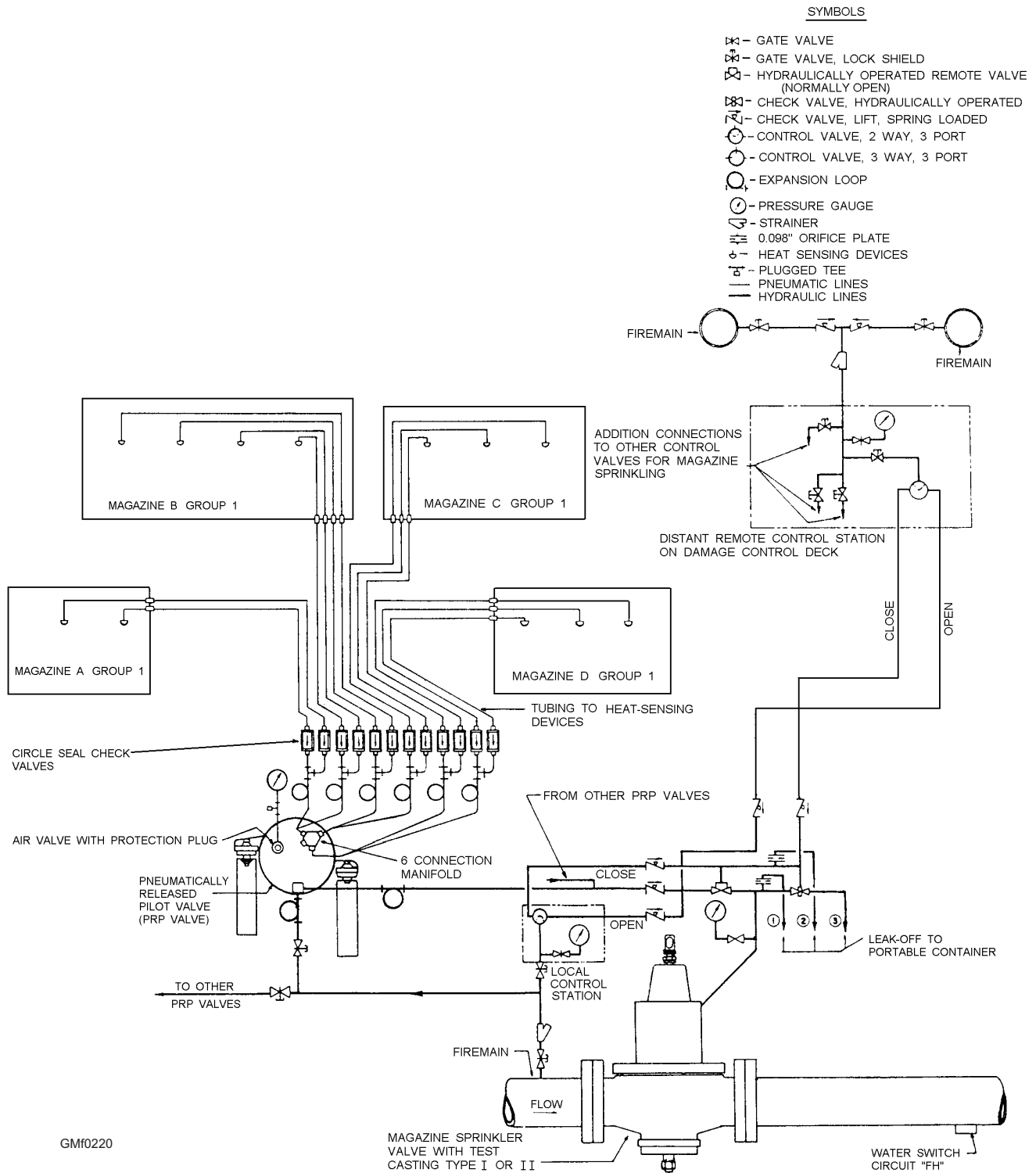


Figure 2-20.—Hydraulic (SW) and thermopneumatic control system for magazine sprinkler valves.

Heat-Sensing Device (HSD)

The HSD (fig. 2-21) is a thin-walled, spring-loaded bellows containing air that is designed to create a pressure in response to either a rapid or slow rise in temperature.

As shown in figure 2-21, HSDs consist of a thin-walled, spring-loaded bellows containing air that creates a pneumatic signal when the device is actuated. The spring and bellows are held in the compressed/expanded positions, respectively, by a fusible link that connects the bellows, device to the HSD housing. The fusible link is designed to part when the link temperature reaches 160EF (± 3 EF).

HSDs are mounted on the overhead of the protected space and are connected to the manifold of the PRP valve by individual 1/8-inch transmission lines. A circle seal check valve is installed in each transmission line.

In the event of a fire, resulting in a rapid rise in temperature in the protected space, heat is absorbed by

the HSD. The heat is conducted to the air within the bellows, causing it to expand and create a pressure. The pressure is transmitted to the rear of the release diaphragm of the PRP valve, thereby creating the differential pressure necessary to trip that valve.

In the event of a smoldering fire, resulting in a slow rise in temperature in a protected space, the pressure created within the bellows increases too slowly to trip the PRP valve. When the temperature reaches 160EF (± 3 EF), the fusible link in the end of the collet parts, thereby removing the restraint holding the bellows. The bellows then collapses under the tension of the spring. The sudden compression creates a pressure impulse that is transmitted to the rear of the release diaphragm of the PRP valve, thereby creating the differential pressure necessary to trip that valve.

Transmission Lines

The transmission lines that connect the thermopneumatic elements to the PRP are rockbestos or rockhide-covered seamless copper tubing.

Vented Check Valve

The vented check valve (fig. 2-22) is a brass, spring-loaded check valve that is designed to check against a rapid change of air pressure in one direction and to open when air pressure is applied in the other direction. One vented check valve is installed in each transmission line (above the PRP and maximum of 12 per PRP) from an HSD with the direction-of-flow arrow pointing toward the PRP. Since the PRP manifold contains only six ports for transmission tubing connection, systems requiring seven or more HSDs will "Tee" together vented check valves, starting with the seventh check valve. The check valves prevent the rapid increase in air pressure created in an individual HSD from pressurizing the entire system. The check valve body contains a vent installed in a bypass around the main valve. The vent permits a slow backflow of air to equalize system pressure in response to normal changes in ambient temperature.

Pneumatically Released Pilot (PRP) Valve

The PRP valve (fig. 2-23) is a normally closed spring-loaded pilot valve that opens automatically to actuate the magazine sprinkler system in response to a pneumatic signal from one or more thermopneumatic elements.

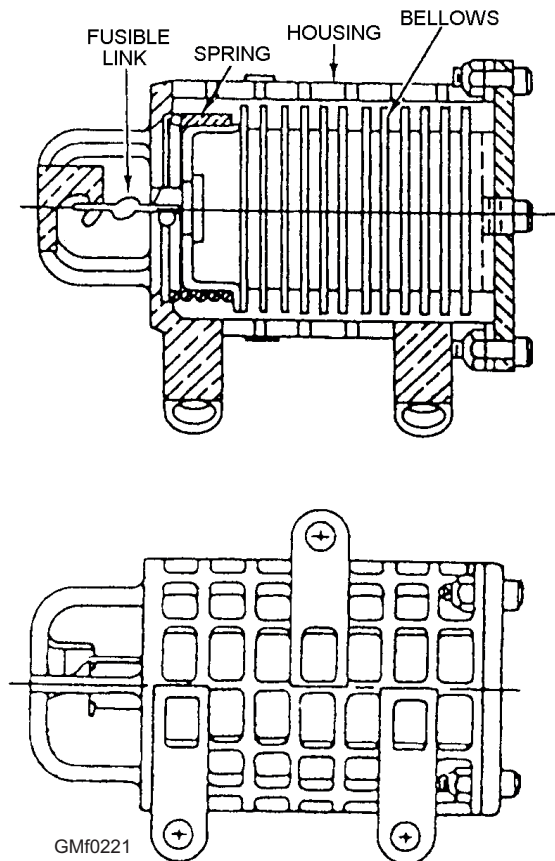


Figure 2-21.—Heat-sensing device (HSD).

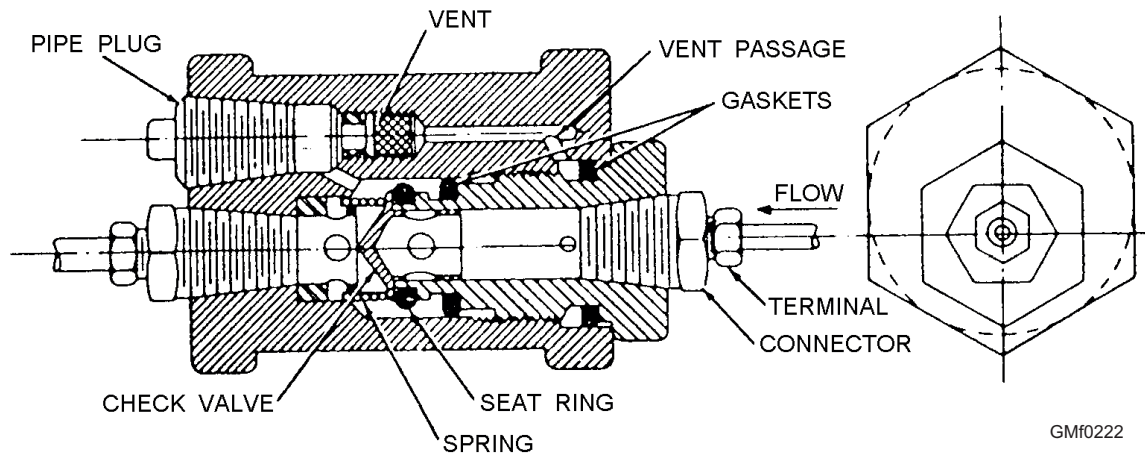


Figure 2-22.—Vented check valve.

The main components of the PRP valve are the operating mechanism, the compensating vent, and the pilot valve. The operating mechanism and compensating vent are housed in a circular bronze case. The pilot valve is mounted on the front of the case. The

pilot valve is installed in a 3/8-inch line that connects the firemain to the sprinkler system hydraulic control system piping. The PRP valve case is provided with shock mounts and brackets for fastening to a bulkhead.

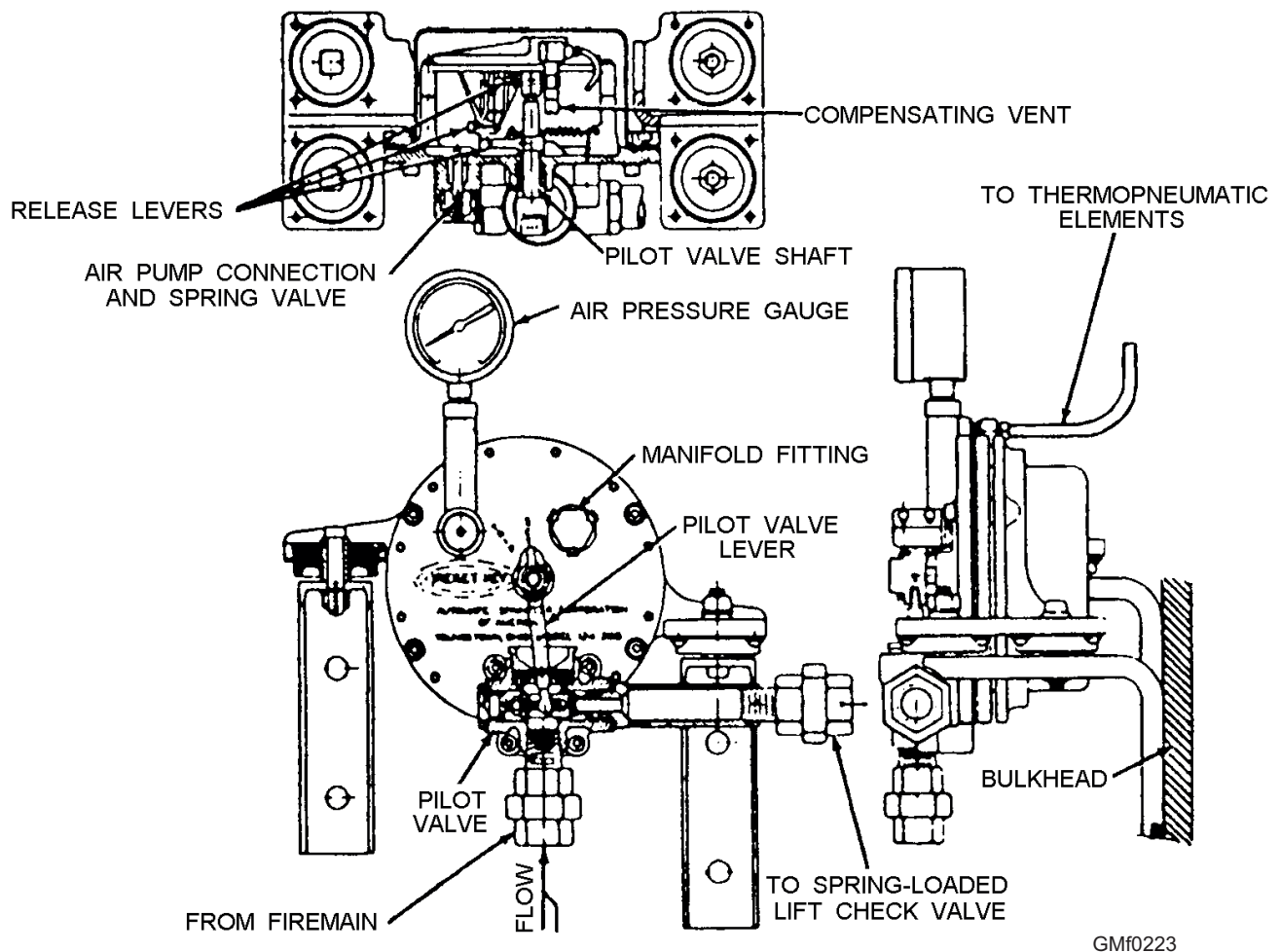


Figure 2-23.—Pneumatically released pilot (PRP) valve.

The operating mechanism consists of a spring-loaded operating lever operated by a release diaphragm through a series of linkages and levers. The rear of the release diaphragm is connected to the tubing from the HSDs. The front of the release diaphragm is open to the interior of the PRP valve case. The compensating vent connects the two sides of the diaphragm. The diaphragm moves to trip the release lever in response to either a sudden or gradual increase in pressure transmitted from one or more HSDs. When the PRP valve is set, the operating lever is cocked to hold the valve closed. When the PRP valve is tripped, the operating lever is released to rotate through a clockwise arc. The angular motion is transmitted to the pilot valve lever by a connecting shaft.

The pilot valve is a cast bronze assembly that houses the valve seat and the seat holder. The end of the pilot valve outlet piping serves as the seat. The seat holder is a Monel cylinder that contains a rubber seat disk bonded to one end and an adjusting screw and locknut on the other end. At assembly, the ball end of the pilot valve lever is inserted in the middle of the seat holder between the adjusting screw and the shoulder of the seat disk. An antichatter spring is provided between the ball of the lever and the back of the seat disk.

The pilot valve lever is designed to pivot about a pin fastened to the PRP valve case. When the PRP valve release diaphragm is tripped, the movement of the pilot valve lever causes the seat holder to move away from the seat, thereby permitting seawater to enter the hydraulic control system piping and actuate the sprinkler system.

The PRP valve is equipped with a compensating vent that functions to "leak off" the slight increases or decreases of pressure within the HSDs caused by normal temperature fluctuations in the protected compartment. This leakoff of slow pressure changes equalizes the pressure on both sides of the release diaphragm and prevents inadvertent tripping of the PRP valve. The compensating vent is calibrated and adjusted at the factory. No adjustments should be undertaken by ship's force.

Accordingly, the rate-of-rise circuit is designed to trip the PRP valve and actuate the sprinkler system when sufficient heat is absorbed by the HSDs to create a definite pressure within the circuit over a given period of time. This pressure acts against the rear of the release diaphragm to create the pressure differential necessary to trip the PRP valve. A slower rate of heat absorption will not cause the system to function, as provision is

made within the PRP valve to compensate for normal temperature changes in the protected space.

The HSDs are connected to the manifold of the PRP valve. In the event of a rapid rise in temperature, the air within the HSD expands and transmits a pressure to the rear of the PRP valve release diaphragm. In the event of a smoldering fire, a fusible link on the end of the HSD parts when the temperature in the space reaches 160EF, ± 3 EF. When the link parts, a spring-loaded bellows is released. The rapid compression of the bellows transmits a pressure to the rear of the PRP valve release diaphragm. In both instances a differential pressure is created to trip the PRP valve.

A differential pressure of at least 8 ounces psi across the release diaphragm is necessary to trip the PRP valve.

NOTE

The gauge mounted on the front of the PRP valve indicates the pressure within the entire system—not the differential pressure. At times the gauge may indicate a positive pressure within the system. This is a normal condition caused by expansion of air within the system as a result of increased ambient temperature. The pressure indicated on the gauge exists on both sides of the PRP valve release diaphragm.

For a complete operating description of all the different magazine sprinkler system configurations, refer to *Magazine Sprinkler Systems*, NAVSEA S9522-AA-HBK-010.

MAGAZINE ALARM SYSTEMS

Several types of warning devices or systems are used on board ship. One of them is the alarm system activated by the water switch (fig. 2-24) on the dry side of the sprinkler system main (group) control valves. This alarm is designated *FH* and indicates by sound or by light when the main control valve is open or leaking. Another type of alarm is the flooding alarm, designated *FD*, that incorporates a float switch located near the deck. As water accumulates on the deck, the float rises, making a set of contacts and sounding an alarm. It is worth considering that, in the event the sprinkler system is actually activated, both alarms would sound within seconds of each other. Remembering this will help you

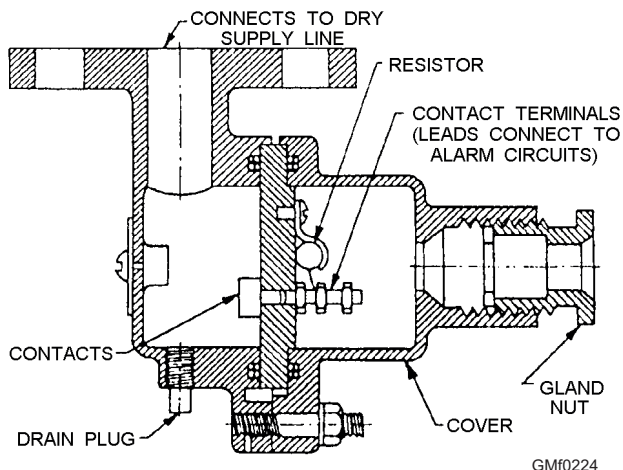


Figure 2-24.—FH alarm sensor.

react appropriately when you receive notification that an alarm has been triggered.

Another type of alarm system used is actuated by heat, designated *F* alarm. This alarm sounds when the temperature in an ammunition stowage area rises to 105EF. With this warning, the temperature can be reduced before sprinkling becomes necessary.

AMMUNITION HANDLING AND SAFETY

LEARNING OBJECTIVES: Identify and describe the equipment and requirements for the safe handling and storage of Navy ammunition. Understand the Qual/Cart program and its associated training.

The safe handling and storage of Navy ammunition requires a high degree of knowledge and skill on the part of all involved. You will be expected to operate heavy equipment and configure ammunition for underway replenishment. You will also be responsible for training and supervising individuals serving as members of ammunition-handling work parties. In this section we will discuss the loading/offloading plan and describe some of the common handling equipment and ammunition-handling training programs. We will also identify some ammunition safety requirement publications that you should use for further study.

Before handling any ordnance, a plan must be formulated and implemented to ensure maximum efficiency and, most importantly, the safety of the evolution. Normally, the basic guidelines for various handling operations may be found in the unit *Standard*

Organization and Regulation Manual (SORM). However, the individual plan for each evolution should be issued as a weapons (or combat systems) department notice or instruction based on the type of operation to be performed.

Arrival Conference

Before or upon arrival of a Navy ship at an explosives pier for loading or offloading of ammunition or other hazardous material, a conference should be held to coordinate safety procedures on the pier and on board ship. The commanding officer or authorized representative of the ammunition activity and the commanding officer of the ship, with other designated ship's personnel, should attend the conference.

LOADING/OFFLOADING PLAN

Prior to loading or offloading any ammunition (other than the small amounts which will be handled by qualified weapons personnel), a workable ammunition-handling plan should be outlined and promulgated in the form of a weapons department notice. The ship's organization manual may include a standard loading plan. If not, you can probably find a previously used plan in your weapons department files of instructions and notices. This plan can be used as a guideline, but will very likely have to be altered to meet present circumstances.

Your loading plan should include the following information:

1. A sketch or drawing showing the positions of all stations where ammunition will be taken aboard; and, if the ship is to be at an anchorage, the positions that all barges, camels, cranes, and associated equipment will take alongside the ship.
2. The types and amounts of ammunition to be taken aboard at each station.
3. A clear description of the route that each type of ammunition will take from the onload station to the magazine.
4. A list of personnel assigned to each station, providing for rotation, chow relief, and change of station upon completion of comparatively short assignments.
5. A list of the ammunition-handling equipment to be supplied at each station by the ship. This equipment should be thoroughly inspected before the operation.

- All persons in a supervisory capacity should receive a copy of this plan. If at all possible, supervising petty officers should be assigned to stations where personnel of their own division are working. This will prove especially helpful should it become necessary to shift large groups to another station during the operation.

1. Ensure that the material is properly boxed in correct shipping containers. Ensure that there are no leaky containers, and that none are broken or so weak as to break during transportation. In those cases where leaky containers or other damaged materials are being turned into an ammunition activity (offloaded), ensure that they are plainly marked and segregated from other materials.
2. Ensure that the total quantity shipped and/or received is in agreement with the invoice (if feasible at this point).
3. Ensure that the material is properly stowed (or stacked and braced in the vehicle to prevent damage to containers or contents) according to applicable regulations.

Restrictions		
QUALIFIED TO OPERATE		
Type Vehicle and/or Equipment	Capacity	Qualifying Official
OTHER RECORDS (Optional)		

* GPO: 1978 O - 261-647 (3525)

mandatory to obtain the U.S. Government Motor Vehicle Operator's Identification Card. Solicitation of the SSN by the United States Civil Service Commission is authorized under provisions of Executive Order 9397, dated November 22, 1943. The SSN is used as an identifier throughout your Federal career from the time of application through retirement.

The SSN will be used by the National Drivers Register Service in conducting a routine check of your driving record. The SSN also will be used by the Civil Service Commission and other Federal agencies in connection with lawful requests for information about you from former employers, educational institutions, financial, law enforcement, or other organizations. The information gathered through the use of the number will be used only as necessary in personnel administration processes carried out in accordance with established regulations and published notices of systems of records. The SSN also will be used for the selection of persons to be included in statistical studies of personnel management matters. The use of the SSN is made necessary because of the large number of present and former Federal employees and applicants who have identities and birth dates, and whose identities can only be distinguished by the SSN.

The BRAVO flag (solid red flag) should be prominently displayed during daylight (a red light at night) by any vessel or barge transporting, onloading, and offloading explosives or ammunition.

OPERATION AT NIGHT

Live ammunition and explosives should not be loaded on or discharged from a ship or lighter at night except in an emergency or when required by the vessel's sailing schedule, or as authorized by NAVSEASYSCOM. Piers should be adequately lighted and equipped with fire protection and safety equipment. If loading or unloading is not completed during the day, proper precautions should be taken to guard and protect against fire, and a sufficient crew should be on hand to adequately cope with emergencies that might arise. If night operations are required, only carefully placed, approved electric lights, portable lanterns, or flashlights should be used inside the ship or lighter, or in the adjacent areas.

Lighting equipment should meet the standards of the National Electric Code as follows:

1. Extension lights should be fitted with exterior globes and stout guards to protect the bulbs.
2. Wire leading to the lights should be sound and heavily insulated and show no evidence of being likely to short circuit.
3. Extension lights should be suspended in such a manner that no strain is carried by the light cable; they are not to be suspended by the cable.
4. Extension lights should be so guarded and protected that neither the light nor the light cable will be in contact with any metal part of the ship, lighter, vehicle, handling equipment, or with any of the ammunition, explosives, or their containers.
5. Extension lights should have an outside power source not connected in any way to the lighter, railroad car, truck, or vehicle.

HANDLING EQUIPMENT

Afloat and ashore, Gunners' Mates handle, store, and transport all types of ammunition and ammunition components. This involves the use of many different types of handling equipment. In this section we will introduce you to industrial materials-handling equipment (MHE) and some of the slings currently in use.

Industrial Materials-Handling Equipment (MHE)

Many sea and shore billets now require Gunners' Mates to perform as industrial MHE operators—most commonly as forklift truck drivers. The forklift truck is an important tool for moving large quantities of pelletized ammunition. Operators of self-propelled forklift trucks are required to complete a physical examination, mental test, and training before being certified to operate the equipment. Figure 2-25 shows the front and back of the operator's identification card. Certification is valid for 1 year.

Forklift trucks are assigned standard alphabetical type designations to identify their fire and explosive safety features and power source. Table 2-2 lists the fire and safety designations for MHE.

Table 2-2.—MHE Fire and Explosion Safety Designations

1. Type D - Diesel-powered, minimum acceptable safeguards against fire hazards (because of its limited use for ordnance handling, this type of truck is not currently procured).
2. Type DS - Diesel-powered, additional safeguards to exhaust, fuel, and electrical systems.
3. Type E - Electrically powered, minimum acceptable safeguards against igniting fire or explosion (because of its limited use for ordnance handling, this type of truck is not normally available at ordnance-handling activities).
4. Type EE - Electrically powered, all the safeguards to type E plus electric motor and all other electric equipment completely enclosed. Generally referred to as spark enclosed.
5. Type EX for Class I, Group D Hazards - Electrically powered, all electrical fixtures and equipment constructed and assembled in such a manner that it may be used in certain atmospheres containing flammable vapors. Generally referred to as explosion-proof.
6. Type G - Gasoline-powered, minimum acceptable safeguards against igniting fire or explosion.
7. Type GS - Gasoline-powered, additional safeguards to exhaust, fuel, and electrical systems over type G.
8. Type H - Hand-powered.
9. Type HS - Hand-powered, nonsparking wheels.

The most common forklift truck is the standard forklift truck, type EE, code 1370 (fig. 2-26). This forklift is currently in use aboard ships and at shore activities. At shore activities this truck is used inside magazines and buildings; a comparable diesel-powered truck is used in open air operations.

For a more detailed description of forklift trucks and other MHE, refer to *Handling Ammunition, Explosives, and Hazardous Materials with Industrial Materials-Handling Equipment (MHE)*, NAVSEA OP-4098.

Safety Precautions For Industrial Materials-Handling Equipment (MHE)

The safety precautions and instructions pertaining to the safe operation and use of ammunition- and explosives-handling equipment prescribed in this section, NAVSEAINST 5100.19, OP 4, OP 5, OP 1014, OP 3347, and the applicable safety manual for particular weapons should be strictly observed by all naval activities, afloat and ashore.

Forklift trucks, pallet trucks, platform trucks, crane trucks, and warehouse tractors and trailers (industrial MHE) are used in various ammunition- and

explosives-handling operations. This equipment is designed to save time and labor. Improper and careless operation or use of this equipment, however, causes accidents, which may result in fatal or serious injury. It may also cause damage to valuable supplies and equipment, resulting in a reduction of the efficiency of the handling operation. Therefore, it is imperative that the safety precautions and instructions prescribed for all kinds of industrial MHE be followed to the letter.

CARGO NETS.—When ammunition is being embarked or discharged from a ship in port, a cargo net should be rigged between the ship and the dock, or between the ship and the ammunition lighter, to catch any ammunition that may be dropped.

Cargo nets should not be used for transferring explosives and ammunition except to enclose a pallet, skip board, or tray. In hoisting or lowering containers with cargo nets, a rigid wooden platform should be fitted in the net.

MATS.—The cargo mat (fig. 2-27) is a closely woven mat having no openings or mesh. The mat is constructed of 3-inch coil, which is a coconut husk fiber rope. The mats are available in two sizes—6-foot square and 4-foot square. The mats are designed with looped eyes on each corner for lifting.

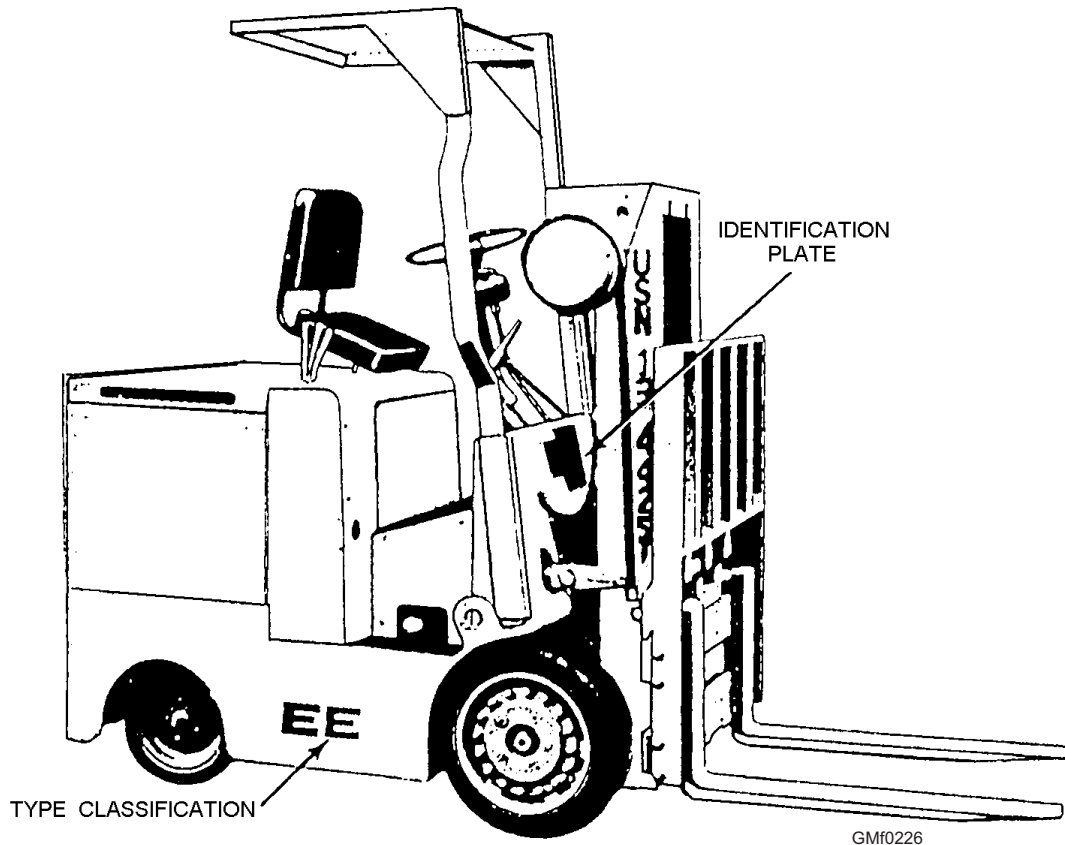


Figure 2-26.—Standard forklift truck, type EE, code 1370.

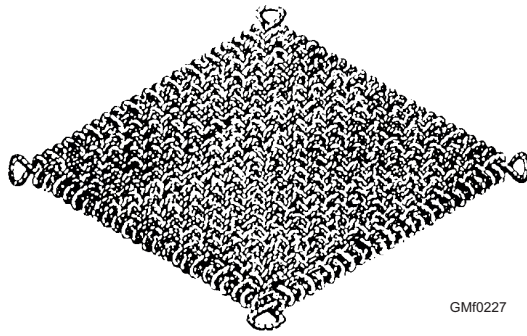


Figure 2-27.—Cargo mat.

The mat is used aboard ship and at shore stations. It is used also inside cargo nets or skip boxes for the protection of the cargo. It is used to cushion the landing of a draft or material that is transferred on a slide.

SKIP BOX.—The cargo-handling box (skip box) (fig. 2-28) is made of wood except for the iron corner angles and stiffeners. This type of handling device is ideal for handling ammunition that is light enough to be handled by hand. The cargo-handling skip box is also used ashore and afloat. The heavy timber skids underneath permit the use of forklift trucks or slings to handle the box.

PALLET ADAPTERS.—The Mk 11 Mod 1 top spacer used with the Mk 11 Mod 1 bottom spacer (fig. 2-29) makes a complete pallet adapter for handling

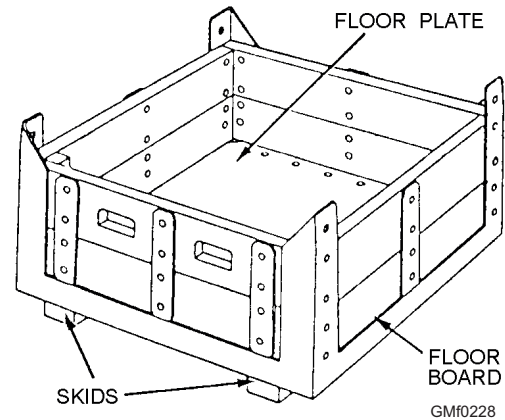


Figure 2-28.—Skip box.

rocket heads and projectiles. The top and bottom spacers are fabricated of steel wire. The bottom spacer has 12 recesses, each of which holds the base of a projectile. The top spacer has 12 equally spaced holders to receive and hold the noses of the projectiles in a vertical position. The top spacer is reversible; one side is used for rocket heads—the other for projectiles. There is a lifting link on each side of the top spacer.

The Mk 11 Mod 1 pallet adapter is used ashore and afloat, and will handle a unit load of 12 5"/54 projectiles. It will also handle 12 5" rocket heads. Flat steel strapping should be used to secure the load on a 40- by 48-inch pallet.

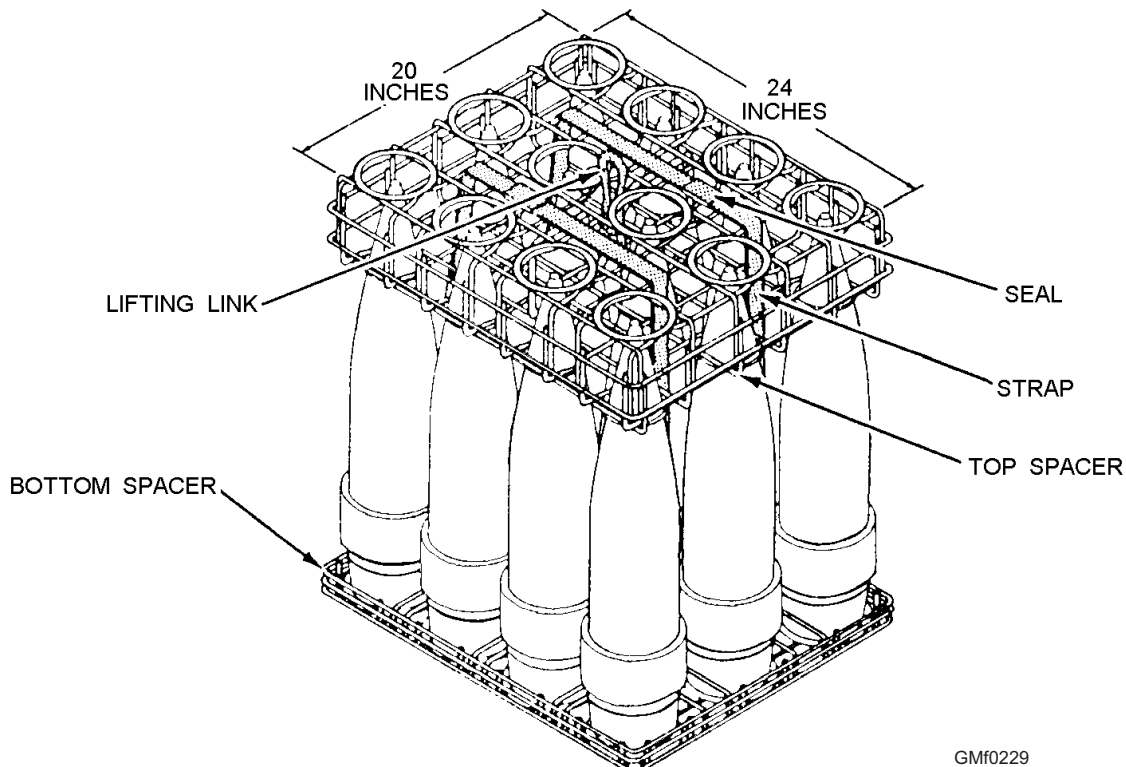


Figure 2-29.—Mk 11 Mod 1 pallet adapter.

The Mk 16 Mod 0 pallet adapter (fig. 2-30) is a complete pallet adapter consisting of a top frame, rear frame, and front frame. It is used aboard ship and at shore stations and is capable of handling a capacity load of 39 5"/54 cartridge tanks. To secure the load on a pallet, flat steel strapping should be used.

Special Handling Regulations for Bulk Explosives and Gun-type Ammunition

Extreme care must be taken in handling black powder, smokeless powder, or other bulk explosives since they are highly flammable and sensitive to friction, shock, sparks, heat, and static electricity. Only nonsparking tools should be used to open containers of these explosives. The special handling instructions prescribed in the paragraphs that follow should be observed when handling gun-type ammunition.

PROJECTILES.—Load projectiles—whether packed or unpacked, grommets, crated, or palletized—should be carefully handled and stowed to avoid detonation or damage to rotating bands, bourrelets, points, caps, windshields, covers, fuze threads, painting, and identification markings. They should be handled by trucks, carriers, and slings. When rolling is the only available means of moving, projectile bodies, windshields, and copper rotation bands should be protected to guard against arming the fuze assembled in the projectile.

Projectiles should not be rolled on the ground, concrete floors, or steel decks, but may be rolled on dunnage boards not less than 1-inch thick.

When a loaded and fuzed projectile is dropped 5 feet or more, it should be set aside, tagged, and turned in to an ammunition activity at the first opportunity—or dumped in deep water—at the discretion of the commanding officer.

Projectile-handling slings that support part of the weight of the projectile on the cap or windshield should not be used on armour-piercing projectiles or on common projectiles fitted with windshields.

Never slide projectiles down a slide without using a restraining line. The base of the projectile should be toward the lower end of the slide.

Detonators, fuzes, booster cavities, and fuze threads should be kept free of all foreign matter except for a light film of specified lubricating preservatives.

Powder Tanks and Cartridge Tanks

Powder tanks containing bag charges should not be rolled or dropped. These tanks should be carried by hand, lift truck, or handtruck, being careful to prevent internal movement and possible ignition of the charge within the tank by static electricity. When lifting and moving such tanked charges, the bottom of the tank should be held lower than the top at all times.

Tanks containing fixed cartridges or separate loaded propelling charges should also be handled carefully to prevent misalignment damage to the round or destruction of close tolerance dimensions. They may be handled with roller conveyors, chutes, or trucks as long as precautions against shocks are observed. Care should be exercised to avoid denting the thin-walled body, opening the body seams, or loosening the top or bottom rings, thereby permitting exposure of the powder to the atmosphere.

When a tank containing a fixed cartridge is dropped a distance of 5 feet or more, the tank and its contents should be set aside, carefully marked, and turned in to an ammunition activity at the first opportunity—or dumped in deep water—at the discretion of the commanding officer.

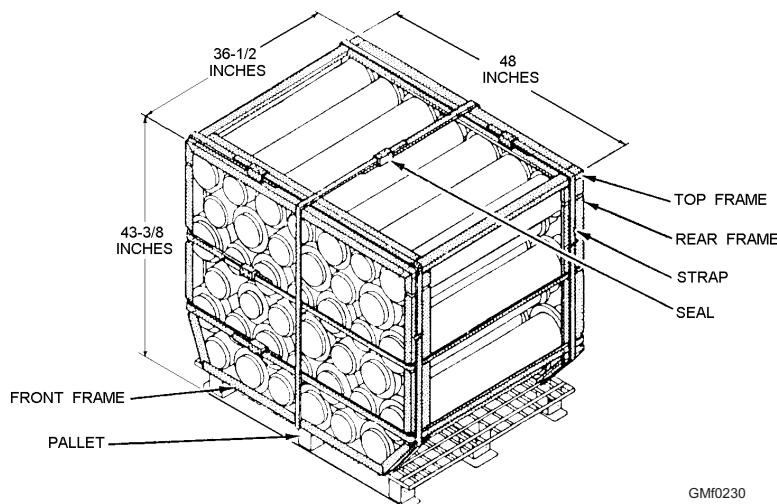


Figure 2-30.—Mk 16 Mod 0 pallet adapter.

EXPLOSIVE COMPONENTS.—Fuzes, boosters, and detonators are loaded with explosives which are sensitive to shock, heat, and friction and must be handled with care at all times.

Every effort should be made to keep component containers sealed airtight when so packed and to limit their exposure to the atmosphere.

Containers of explosive blasting caps and fuzes should not be left uncovered and must be in the custody of authorized personnel at all time.

Wooden containers containing explosive components should be opened carefully using only approved spark-resistant tools. A wire, nail, or sharp instrument should **NEVER** be used to pry open the container.

SMALL ARMS.—It cannot be emphasized too strongly that inadvertent and improper use of small arms and small arms ammunition has resulted in numerous casualties. Invariably, the basic cause of each casualty is carelessness.

Cartridge cases should not be polished. Corrosion, moisture, and dirt, however, should be wiped off. The ammunition should be protected from shock, which might dent it or fire the primer.

Ammunition should not be broken down except to make necessary examinations or when preparing ammunition for target practice or action. Small arms ammunition should not be opened until the ammunition is required for use. No reworking, overhaul, or modifying of any live-loaded ammunition or component is permitted on board ship.

SLINGS.—Bulk ammunition is most often moved in palletized loads. Slings are used to facilitate the movement of these standard size loads by helicopter and underway replenishment. Aboard ship you will find a wide variety of slings for moving ammunition. The slings most commonly used for moving gun ammunition are the Mk 85, 86, 87, and 100. All of these are size variations of the same type of adjustable sling (fig. 2-31). These slings are adjustable for different heights of pallets. The different versions are easily identified by the color-coded tubing attached to the cross bridle.

For more information on slings and other weapons-handling equipment, refer to *Approved Handling Equipment for Weapons and Explosives*, NAVSEA OP-2173, volumes 1 and 2.

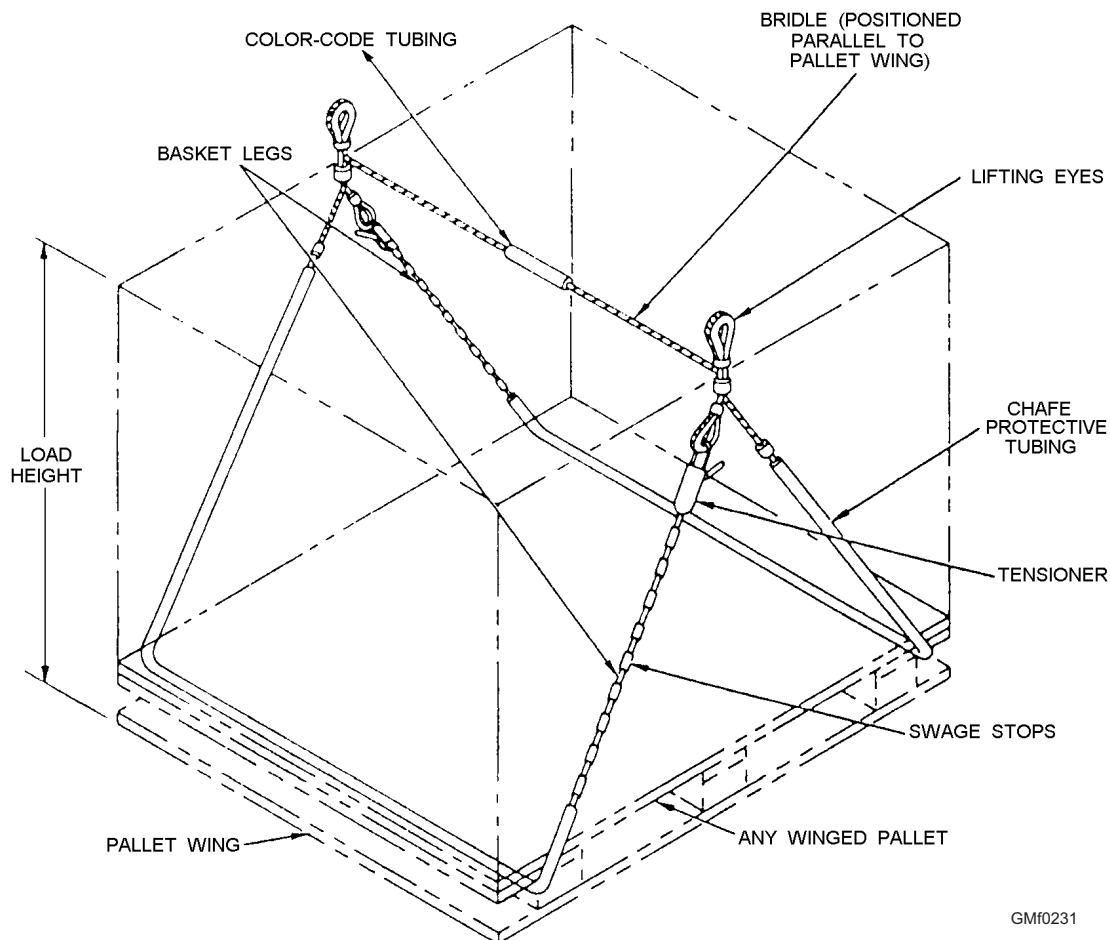


Figure 2-31.—Adjustable pallet sling.

EXPLOSIVES-HANDLING PERSONNEL QUALIFICATION AND CERTIFICATION (QUAL/CERT) PROGRAM

The requirements of the Explosives-Handling Personnel Qualification and Certification (Qual/Cert) program are defined in COMNAVSURFLANTINST 8023.4/COMNAVSURFPACINST 8023.5. The program consists of a series of certification levels, definitions of work tasks, and categories or families of

explosive devices. Anyone who handles ammunition or operates ammunition-handling equipment must be certified under this program. Remember, this also pertains to gun mount and missile launcher operators.

An individual is trained and certified to perform specific work tasks on individual families of ordnance. Refer to tables 2-3, 2-4, and 2-5 for definitions of certification levels, work tasks, and a sample of families of explosive devices.

Table 2-3.—Certification Level Qualification Standards

CERTIFICATION LEVEL	QUALIFICATION STANDARD
In Training (IT)	<ol style="list-style-type: none"> 1. Incumbent is required, by nature of duty, to perform work tasks with explosive devices while under direct supervision of a certified team leader (TL) or individual (I). 2. Incumbent is receiving training on newly introduced explosive devices for which inert training devices are not available. 3. Incumbent shall not work with explosives unless supervised by TL or I. 4. This level of certification is temporary until such time full qualification justifies certification at a higher level, for example, TM, or I.
Team Member (TM)	<p>BASIC QUALIFICATION. Personnel are aware of basic safety precautions relative to the work task and explosive devices concerned, have received formal and/or on-the-job training, and have been recommended by their immediate supervisor. May not work with ordnance unless supervised by TL or I.</p> <p>NOTE: TM-certified personnel will perform in team concept only under supervision of a certified TL.</p>
Individual (I)	<ol style="list-style-type: none"> 1. Same as for team member (TM) above. 2. Has sufficient knowledge and has demonstrated the proficiency of the work task alone, or trains others in safe and reliable operations. 3. Capable of interpreting the requirements, applicable checklists, SOP, and assembly/operating manuals.
Team Leader (TL)	<ol style="list-style-type: none"> 1. Same as for TM and I above. 2. Has sufficient knowledge and has demonstrated the proficiency to direct the performance or training of others, in safe and reliable operations.
Quality Assurance (QA)	<ol style="list-style-type: none"> 1. Same as I or TL above. 2. Must have detailed knowledge and ability to train others in applicable explosive device/systems inspection criteria and be able to decide that the necessary assembly or installation procedures have been completed per applicable directives. <p>NOTE: Only TM, I, TL, and QA are interrelated. Certification at the QA level automatically assumes the individual has all knowledge and skill levels required of the TM, I, and TL member.</p>
Safety Observer (SO)	<ol style="list-style-type: none"> 1. Must have sufficient knowledge of safety <u>procedures</u> and the <u>functioning</u> of <u>safety devices</u> to decide subsequent reaction when safety procedures or devices are not properly used. 2. Certification at the SO level does not require prior certification at any other level. <p>NOTE: The certification level is not restricted to the most senior within a unit. A junior who possesses the foregoing standards and demonstrated maturity may likewise be certified.</p>

Table 2-4.—Work Task Code Definitions

1. <u>Stowage</u> — The physical act of stowing explosive devices in designated and approved magazines and ready service lockers.
2. <u>Handling</u> — The physical act of moving explosive devices manually or with powered equipment within the confines of the ship or within an area authorized for handling ashore.
3. <u>Assembly/Disassembly</u> — Physically mating/unmating explosive device components to form a complete round including torpedo banding. This work task code is used only when assembly/disassembly of the explosive device is authorized at the fleet level.
4. <u>Load/Download</u> — The physical act of installing/removing explosive devices including cartridge-actuated devices into/from the vehicle from which initiation is/was intended, for example, launchers, projectors, racks, and gun barrels.
5. <u>Arm/De-arm</u> — The physical act rendering explosive devices from a safe condition to ready-for-initiation or returning explosive devices from the ready-for-initiation state to a safe condition.
6. <u>Explosive Driver</u> — An individual who operates self-propelled material handling equipment to transport explosive devices either ashore or afloat. Must meet all requirements of NAVSEA OP 4098 (and COMNAVSURFLANTINST 9093.3 for NAVSURFLANT activities) as a qualification standard before certification.
7. <u>Magazine Inspection</u> — Capability of detecting improperly secured stowage, unsatisfactory packaging, unusual fumes or odors and any other abnormal conditions as defined in NAVSEA OP 4/NAVSEA OP 5 and appropriate maintenance requirement cards (MRC) in explosive devices stowage spaces, magazines, and lockers.
8. <u>Missile System Cycling/Maintenance</u> — Physical act of conducting cyclic operational tests, troubleshooting, repair, and performance of periodic maintenance of GMLS.
9. <u>Gun System Cycling/Maintenance</u> — Physical act of conducting cyclic operational tests, troubleshooting, repair, and performance of periodic maintenance of gun systems.
10. <u>Torpedo System Cycling/Maintenance</u> — Physical act of conducting cyclic operational tests, troubleshooting, repair, and performance of periodic maintenance of torpedo systems.
11. <u>Equipment Operator</u> — An individual who operates non-mobile powered handling equipment (hoists, winches, cranes, elevators, conveyors/transporters, and so on) for handling explosive devices.
12. <u>Testing</u> — The physical act of conducting tests on explosive/firing devices, for example, AIM-9 umbilical tests, continuity tests on SUU-25/44 flare dispensers and LAU 61/68/10 rocket launchers.
13. <u>Sprinkler System</u> — The physical act of maintaining troubleshooting, testing, flushing, and operating shipboard sprinkler systems (wet or dry as applicable).

Table 2-5.—Families of Explosive Devices (partial list)

- | |
|--|
| <ol style="list-style-type: none"> 1. Gun ammunition <ol style="list-style-type: none"> a. Propelling charges <ol style="list-style-type: none"> (1) Bag charges (2) Cartridge cases b. Projectiles (separate loading) c. Fixed ammunition (through 76-mm) d. Fixed ammunition (3" and above) e. Saluting charges f. Small arms ammunition 2. Rockets <ol style="list-style-type: none"> a. CHAFROC b. RBOC/SRBOC c. Warhead, 2.75" d. Warhead, 5.0" e. Fuzes, nose f. 2.75" motors (Mk 4/Mk 40/Mk 66) g. 5.0" motors launcher (Mk 71/Mk 72) h. 5.0" rocket launcher (LAU-10) i. 2.75" rocket launcher (LAU 61B/A and LAU 68C/A) j. 2.75" rocket launcher (LAU 61C/A and LAU 68D/A) k. Smokey Sam Simulator rocket and igniter |
|--|

The key to the Qual/Cert program is documented training. In the past, ammunition handlers were arbitrarily certified without recorded training to substantiate the certification awarded. This is no longer the case. Your certification is worthless without documented training in your training record. Figure 2-32 shows a sample certification sheet for an individual certified to handle and stow small arms ammunition, gun projectiles, and cartridge-case-type propelling charges at the team member level.

The Qual/Cert board is appointed in writing by each unit's commanding officer. Each board member, except the chairman, should be certified at or above the level to which he or she is allowed to sign on the certification sheet.

AMMUNITION SAFETY

The utmost care and prudence must be exercised in supervising the handling, inspecting, preparing, assembling, and transporting of all ammunition. People tend to become careless and indifferent when continually engaged in routine work and, as long as nothing occurs, are naturally inclined to drift gradually into neglecting the necessary safety precautions. This

cannot be tolerated when handling explosives. Nothing but constant vigilance on the part of everyone involved will ensure the steadfast observance of the rules and regulations that experience has taught to be necessary.

It is not practical to list all the safety requirements pertaining to ammunition handling in this manual. As you proceed through the Qual/Cert program, you will receive training on each safety requirement and its application in detail. Pay particular attention to the publications and instructions identified throughout this chapter that contain the bulk of ammunition-handling and safety requirements.

Safety is everyone's responsibility. An awareness of the potential danger, a knowledge of how this danger can be avoided, and a constant vigilance are required to prevent accidents when working with explosives. If a thorough understanding of the precautions is developed, unsafe conditions can be recognized and corrected. Hopefully, it will prepare you to act instinctively when the unexpected occurs. It is your responsibility as a Gunners' Mate to exhibit an expert knowledge of ammunition safety requirements. Safety precautions pertaining to the handling of and working with explosives are contained in *Ammunition Afloat*, OP 4; *Ammunition Ashore*, OP 5; *Ordnance Safety*

[illegible]

Figure 2-32.—Sample certification sheet.

Precautions, Their Origin and Necessity, OP 1014; and *United States Ordnance Safety Precautions*, OP 3347. Read and reread these publications.

Safety precautions, rules, and regulations for handling explosives should be made the subject of frequent training and review. The necessity for strict compliance with these precautions should be firmly

fixed in the minds and habits of everyone involved in handling explosives. You need to be able to react positively in an emergency.

Attention to Safety

Your attention is particularly invited to the fact that in the early stages of the use of explosives, experience

was gained at a great price, not only in dollars, but in human lives. No relaxation should be tolerated, since this tends to create the impression that safety rules are arbitrary.

Working Parties

Ammunition-handling working party personnel are not required to be certified under the Qual/Cert program. *Explosives-Handling Personnel Qualification and Certification (Qual/Cert) Program*, COMNAVSURFLANTINST 8023.4/COMNAVSURFPACINST 8023.5, requires working party personnel to receive training and a safety brief before each handling evolution and to be closely supervised by certified personnel.

ELECTROMAGNETIC RADIATION HAZARD

Some ordnance, such as rocket ammunition, may be susceptible to ignition by electromagnetic radiation (from such sources as radar or radio transmitters). This condition is called Hazards of Electromagnetic Radiation to Ordnance (HERO). Information regarding the protection of ordnance material from radiation hazards is contained in NAVSEA OP 3565/NAVAIR 16-1-529/NAVELEX 0967-LP-624-6010.

QUANTITY-DISTANCE (Q-D)

Quantity-Distance (Q-D) is the area between two or more explosive-loaded ships, magazines, piers, facilities, and so forth, figured into a safe handling zone. This Q-D relationship is such that if one ship with mass-detonating explosives were to explode, damage to the surrounding area would be minimized by its distance from other local units or facilities. This Q-D area is determined by the amount of explosive material contained by the units or facilities involved. The amount of explosives is computed in pounds. This weight value is called Net Equivalent Explosive Weight (NEEW). NEEW is the weight of the actual explosive content in an ordnance unit. The formulas for computing NEEW are contained in NAVSEA OP 5. An illustration of a typical application of quantity-distance requirements for inport ammunition handling is shown in figure 2-33. The basic purpose of showing this illustration here is to give you an idea of the magnitude of computations involved in a Q-D problem. The columns and tables referred to in this figure are located in NAVSEA OP 5, volume 1. You will need to refer to this publication to fully understand the legend accompanying this figure. NAVSEA OP 5, volume 2 provides more specific information about Q-D requirements.

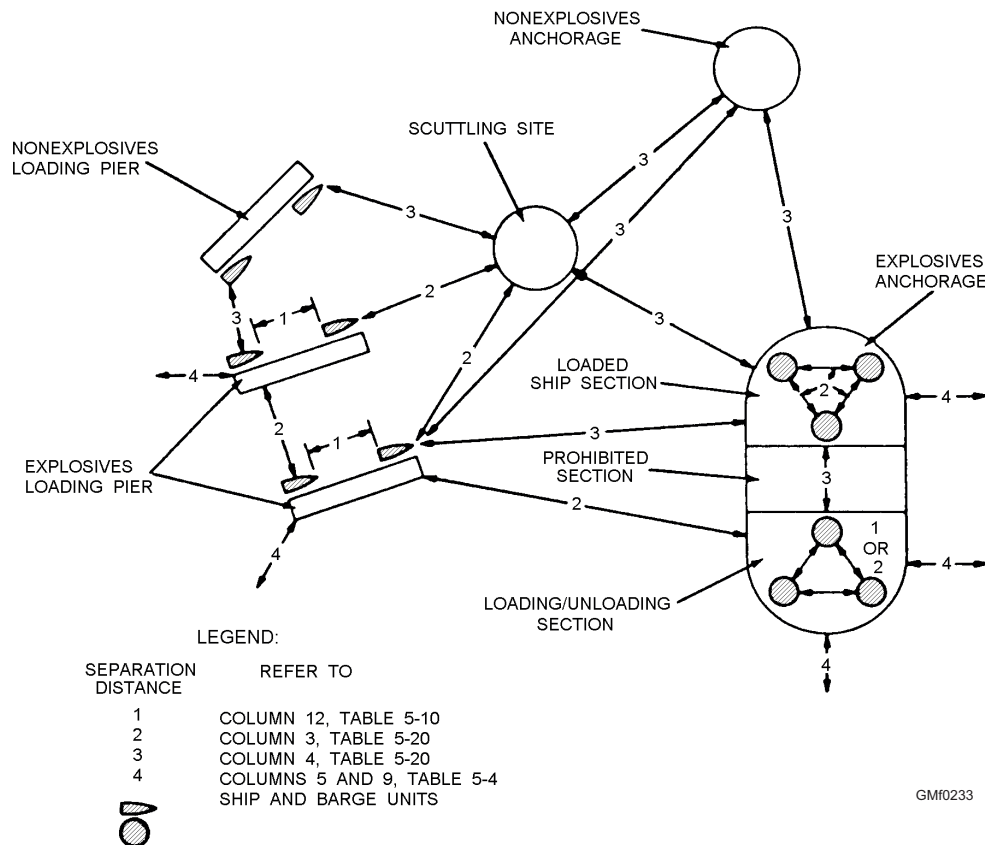


Figure 2-33.—Typical application of quantity-distance at port facilities.

MISSILE HANDLING

LEARNING OBJECTIVE: Recall missile handling information, to include weapons station processing; issue and receipt processing; containers, canisters and handling equipment operations; and replenishment methods.

Where do missiles come from and how do they get aboard ship? As a GM, you must know the answers to those questions. Figure 2-34 illustrates the key steps in the processing and handling of missiles. Study it for a moment. Notice that some of the directional arrows go both ways.

WEAPONS STATION PROCESSING

Guided missiles originate at a naval weapons station (NWS or WPNSTA). It is a shore activity whose primary mission is to supply the fleet with all types of ammunition. The major NWSs in the continental United States (CONUS) are at Concord, California; Seal Beach, California; Earle, New Jersey; Yorktown, Virginia; and Charleston, South Carolina. There are

other smaller ammunition handling activities located throughout CONUS and overseas.

Gunner's Mates are frequently assigned (shore) duty at NWSs. If you get such an assignment, you will be involved with many phases of missile processing. The level of missile maintenance done at an NWS is more detailed and technically oriented than that accomplished aboard ship. The following paragraphs briefly summarize some of the major NWS missile processing events. (Refer to fig. 2-34.)

Issue Processing

Individual missile sections are received from civilian manufacturers. When the components arrive at the NWS, they are placed in stowage. Each component (warhead section, guidance section, etc.) is shipped in its own specialized container. As needed to fulfill fleet requirements, the individual components are unpacked and inspected. The sections are tested separately and then carefully assembled to "build" a complete missile.

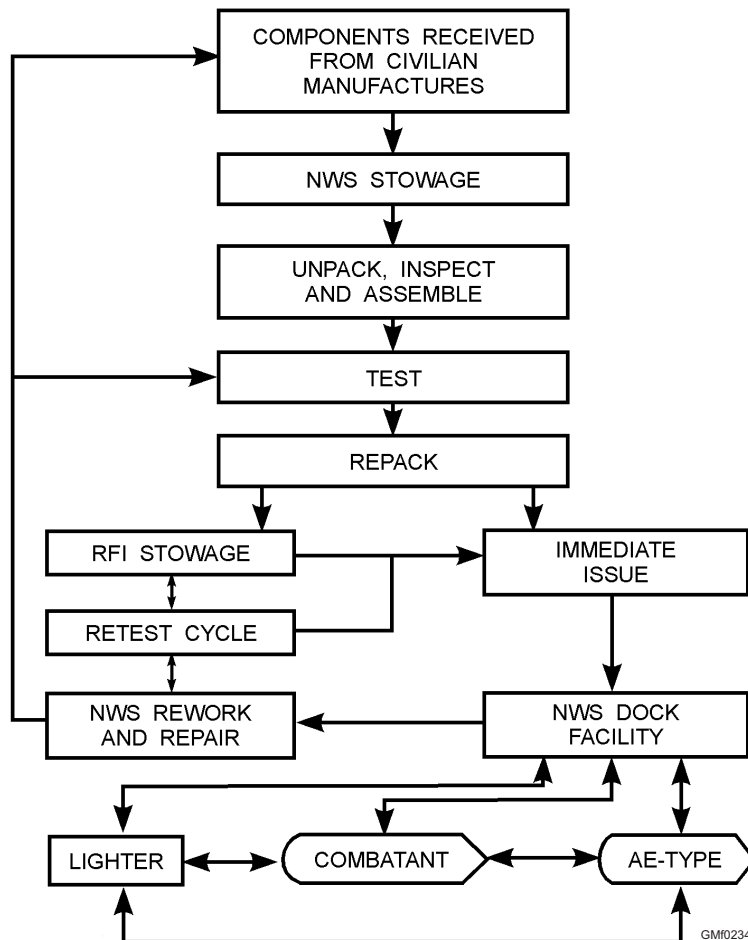


Figure 2-34.—The major sequences of missile processing and handling.

The fully assembled missile undergoes more testing. Strict quality assurance (QA) standards are checked and double-checked throughout the entire process. When the missile is completely ready, it is certified and classified as an all-up-round (AUR).

The AUR missile is then placed into a missile shipping/stowage container. The round is then transported to either of two locations. If the missile will be issued to the fleet in the near future, it is moved to ready-for-issue (RFI) stowage. Although RFI stowage is only temporary, the weapon will still be checked and inspected regularly.

If the missile will be issued to a fleet unit (ship) immediately, it is moved to the NWS's dock facility. Railroad cars or trucks are used to transport the missile to the loading area/pier. When it arrives at the staging area on the pier, the missile is removed from its container. Normally, the round will be loaded into a missile transfer dolly. The transfer dolly is then moved to the ship, and GMLS strikdown operations take place. (There are other ways to handle missiles on the pier and we'll discuss them later.)

The operation just described could be as simple as delivering one missile to a combatant ship. However, NWSs are capable of replenishing the entire ammunition inventory of any type and size of ship, combatant or otherwise. Ammunition cargo carriers, such as AE- and AOE-type ships and specially contracted commercial vessels, are major customers at an NWS. Although they carry a much smaller capacity of ammunition, AO- and AOR-type ships also are replenished at an NWS. Occasionally, the NWS will load ammunition onto a lighter (ammunition barge). The lighter is then moved to the receiving ship's location and the ammunition transfer conducted at an anchorage.

Receipt Processing

NWSs are equipped to receive missiles (and other munitions) from fleet units. Missiles returned to an NWS are generally in one of two conditions—serviceable or damaged.

A serviceable missile is one that is still in good shape. It may, however, have reached its expiration date. Usually, the age of a missile's explosive and propellant grains is used to establish a "shelf-life" for the round. Beyond that shelf life, the reliability of the weapon may be in question. So it is turned in to be checked. When a ship goes into overhaul, all its ammunition, including serviceable missiles, will be

off-loaded at an NWS. Only a small amount of small-arms ammunition will be retained on board.

After a serviceable missile is received at the NWS, it is moved to a rework/repair shop. (See fig. 2-34.) The missile is disassembled and given a complete (inside and out) inspection. Modifications and update alterations are installed and all surfaces are cleaned and preserved. The missile is reassembled, tested, and recertified for fleet use. It is moved to RFI stowage or immediately reissued to a fleet unit. Essentially, the missile undergoes its own overhaul and remains within the Navy's ammunition inventory. That is a cost-effective and time-saving arrangement.

If a missile is damaged or suspected of being damaged, it must be turned in to an NWS. That should be done as soon as possible. For deployed units, it may mean transferring the missile to an AE-type ship first. The AE will return the round to an NWS along with the combatant ship's damage report.

Missile damage can result from various causes. Examples include rough handling, wetdown (from a sprinkler system), excessive temperatures, or dud/misfire failures. The NWS accepts these "bad" rounds and conducts a very thorough investigation. If the damage is minor, the NWS makes the necessary repairs and readies the missile for reissue. Sometimes the damage is major and beyond the repair capabilities of the NWS. In that case, the affected section(s) are returned to an industrial repair facility for rework. If the repair cannot be done economically, the section(s) are disposed of according to current instructions.

In summary, naval weapons stations provide several valuable services to the ordnance community. They act as major stock points, injecting new weapons and munitions into the fleet while removing the old and unserviceable items. They also act as maintenance and repair facilities to provide the fleet with the best weapons and munitions possible. The NWS activities play an important role in contributing to the high state of fleet readiness.

CONTAINERS, CANISTERS, AND HANDLING EQUIPMENT

Guided missiles are sturdy, well-constructed machines. But, because of their size, weight, and bulk, they are not that easy to handle. Nor are missiles indestructible. Most missile damage is, unfortunately, a result of carelessness and poor handling practices.

To reduce the possibility of damage, missiles are shipped, stowed, and handled with special equipments. Approved containers, canisters, and handling equipments provide maximum missile safety with minimum handling by personnel.

There are hundreds of different and specialized types of containers, canisters, and handling equipments in the ordnance field. Many are designed for a single purpose or use and cannot be interchanged with comparable items. Certain equipments are found only at an NWS or aboard an AE-type ship. The equipments covered in this text represent those you need to know about at this point in your career. Essentially, they are the containers, canisters, and handling equipments used to deliver missiles to a ship.

Containers and Canisters

Missile containers are large, rectangular aluminum boxes used for the shipment and stowage of missiles. Normally, combatant ships do not carry containers on board. Containers are under the cognizant control of the Navy Ships Parts Control Center (SPCC), Mechanicsburg, Pennsylvania. They are maintained by the NWSs and AE-type ships.

Canisters serve as the stowage and launch tube for the missile when installed on vertical launching system (VLS) ships. Also, with packaging, handling, storage, and transportation (PHST) equipment attached, the canister serves as the missile shipping container.

Missile containers and canisters are identified by a mark and mod number. Become familiar with these numbers. We will discuss the following containers and canisters:

1. Mk 372 container – Standard missiles (SM)
2. Mk 632 container – Harpoon missiles
3. Mk 183 container – ASROC missiles
4. Mk 13 canister VLS – Standard SM-2 all-up-round (AUR) missiles Block II, III, IIIA, and IIIB
5. Mk 14 Mod 0 and 1 canister VLS – Tomahawk AUR
6. Mk 15 canister VLS – ASROC missiles

MK 372 CONTAINER.—The Mk 372 Mod 5 container is used to ship and stow medium range (MR) Standard missiles (fig. 2-35).

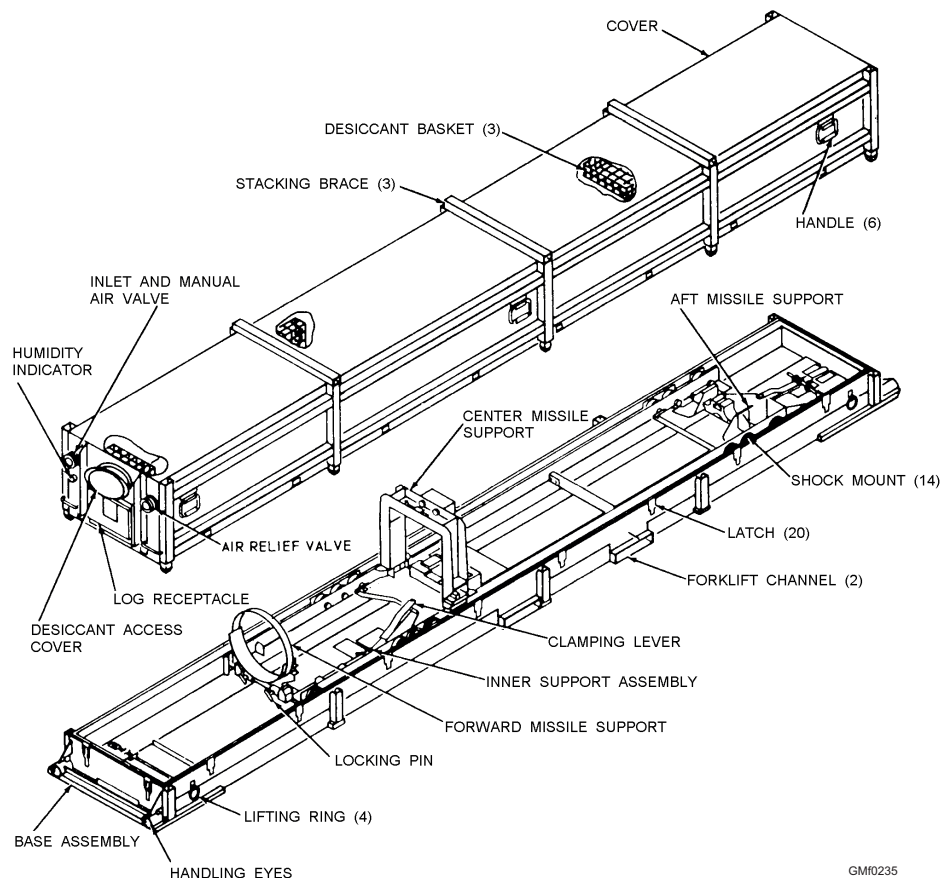


Figure 2-35.—Mk 372 Mod 5 container for Standard MR missiles.

The bottom section of the container has an inner support (base) assembly. It is shock-mounted to the outer base assembly. A missile is secured to the inner assembly with its lower forward and aft launching shoes. A center missile support (U-frame) is installed over the upper forward launching shoe. It provides a downward force on the shoe and helps secure the missile. A clamping lever (or humping fork) is located below the center missile support. It also aids in securing and prevents the missile from sliding forward.

The rectangular top cover is secured to the base by suitcase-type latches. The cover has a log receptacle, a desiccant access cover, and two air relief (breather) valves. More desiccant baskets are bolted to the inside

of the cover. They are filled when the container is open. A humidity indicator is located on one end of the cover.

The Mk 372 container may be lifted by sling, forklift truck, or handlift trucks. The sling attaches to four lifting rings at the corners of the base. Two forklift channels are provided in the center of the base for forklift truck tines. Four handling eyes (two on each end of the base) permit handlift truck handling.

MK 632 CONTAINER.—The Mk 632 Mod 0 container (fig. 2-36) is used to ship and stow Standard-launched Harpoon missiles. Physically and functionally it is somewhat similar to a Mk 372 container.

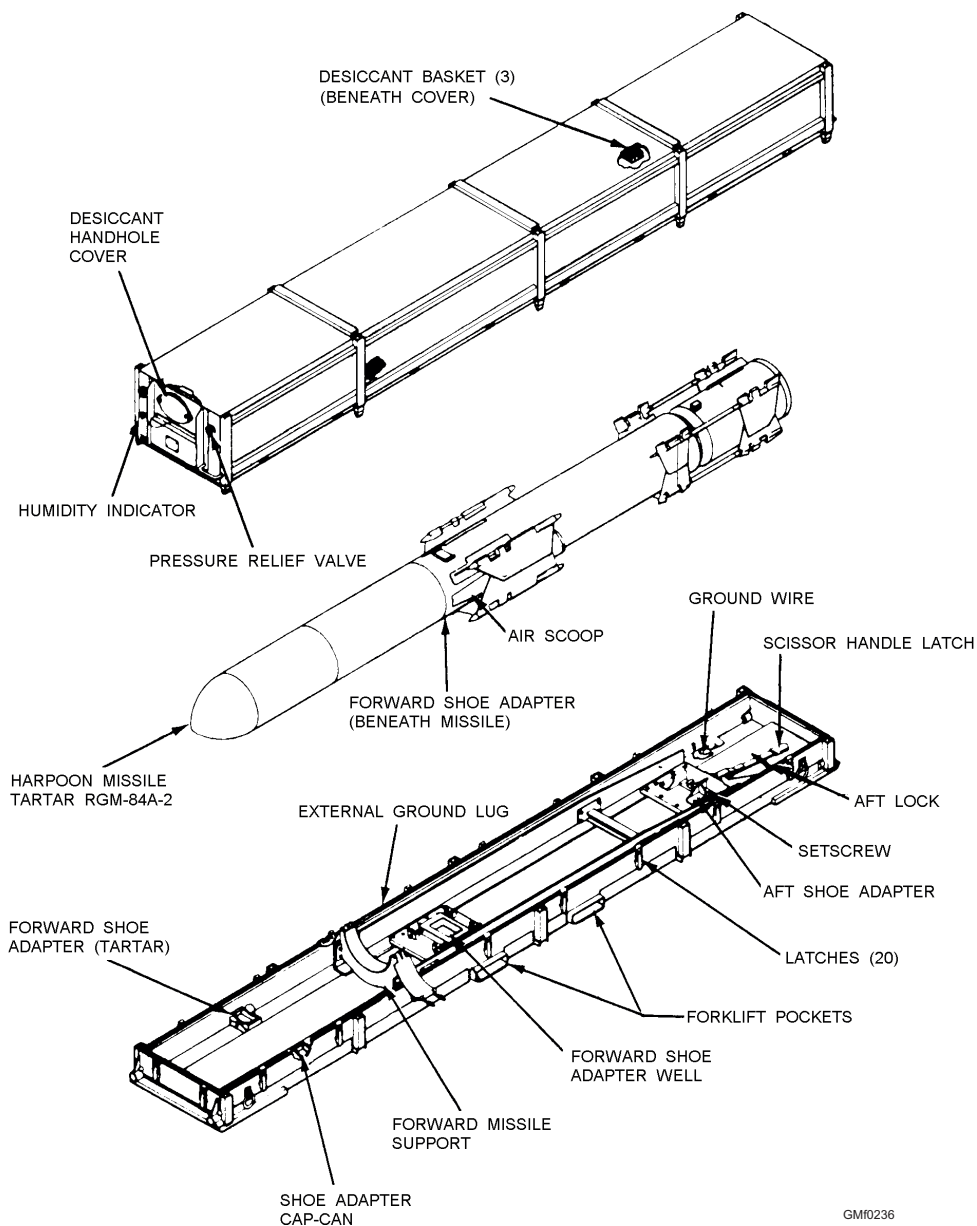


Figure 2-36.—Mk 632 Mod 0 container for Harpoon missiles.

MK 183 CONTAINER.—The Mk 183 container is used to handle ASROC missiles. Figure 2-37 shows an external view of the container. Note the prominent extensions on the top cover. They accommodate the fins of the missile. This container may be handled by sling, forklift truck, and handlift trucks too.

There are five different types of canisters currently in use on VLS ships: Mk 13 Mod 0, Mk 14 Mods 0 and 1, Mk 15 Mod 0, Mk 21 Mod 0, and the Mk 19 Mod 0 nontactical training canister. A 16 pin coding plug in each canister is used by the VLS to identify the type, payload, and Down-Link Frequency code of the missile. A temperature sensor is used to monitor the internal canister temperature. The launcher sequencer monitors the sensor and activates the deluge system when the internal canister temperature exceeds 190°F, except during a launch. The deluge connector is coupled with the launchers quick-disconnect deluge hose. The antenna connector accepts a coaxial cable from the ships telemetry monitoring equipment to receive telemetry data from the antenna of a telemetry missile in the canister before launch. The canisters 145

pin umbilical connector is housed in a shielded box assembly which mates with the canister cable and conduit inside the canister so the launch sequencer can monitor the missile and transfer launch data. The canister safe/enable switch (CSES) is a manually activated switch that interrupts critical signals required to arm and launch missiles. End covers environmentally seal the missile canister. The aft cover is designed to allow the missile exhaust gases to flow by while still providing structural support. The forward cover is a fly-through cover. Internal components, such as rails, snubbers and deluge manifolds, are different in each type of canister. The shell structure is a steel shell with lengthwise reinforcements, and the interior and exterior surfaces are coated with an anticorrosive material. Each canister is 25 inches square but varies in length. The Mk 13 Mod 0, Mk 15 Mod 0, and Mk 19 Mod 0 canisters are 230 inches long. The Mk 14 Mods 0 & 1 and Mk 21 Mod 0 canisters are 265 inches long.

MK 13 MOD 0 VLS CANISTER.—The Mk 13 Mod 0 canister houses the SM-2 BLK 11, 111, 111A,

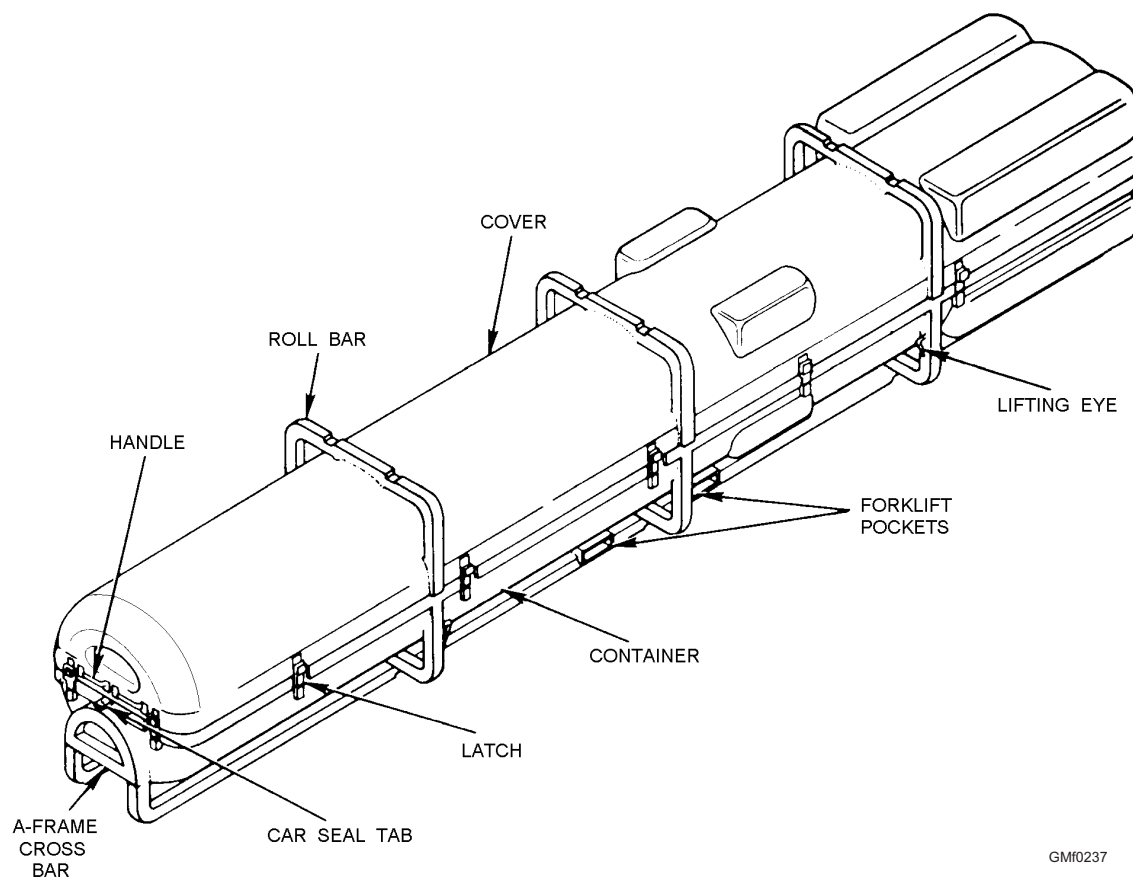
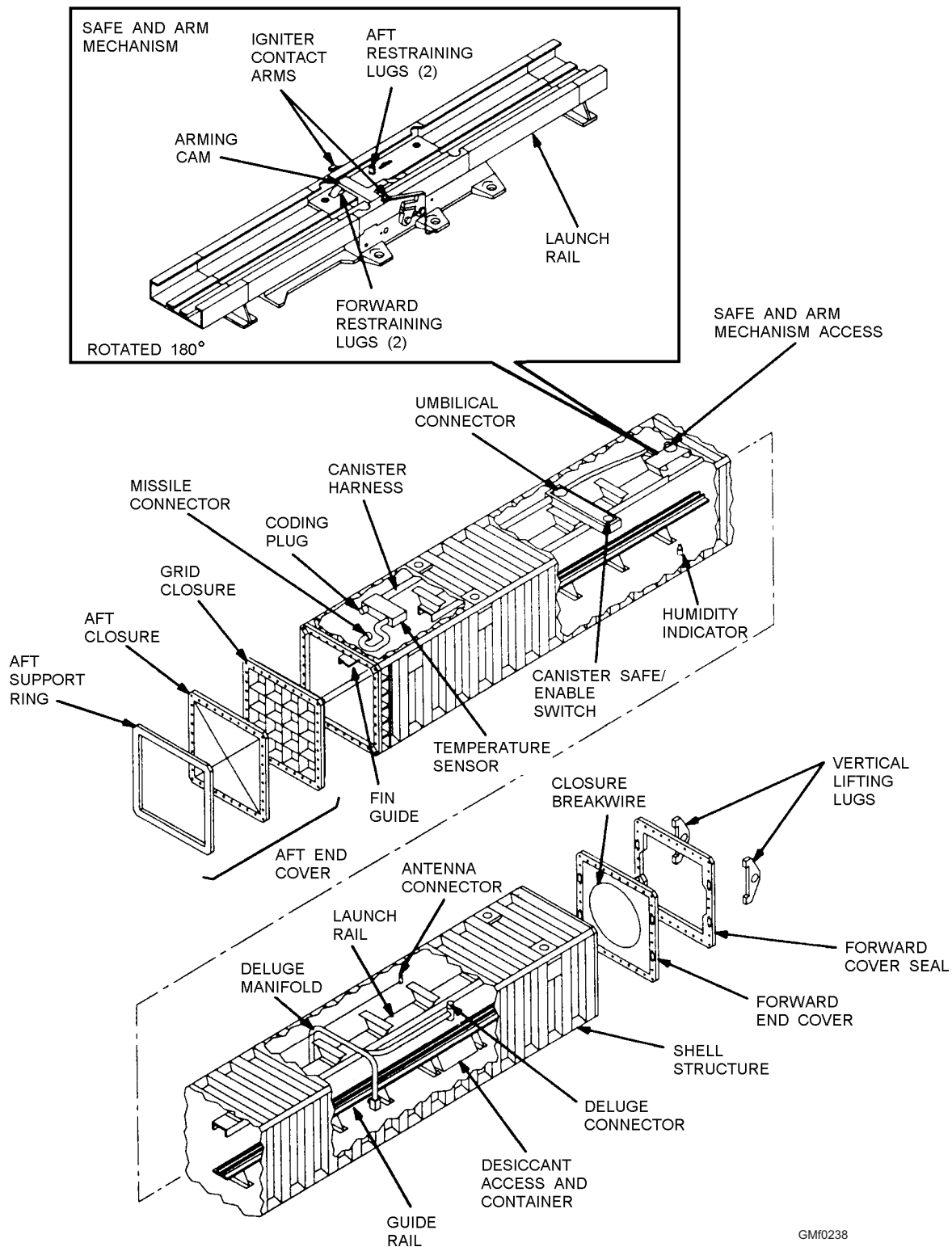


Figure 2-37.—Mk 183 container for ASROC missiles.

and 111B missiles (fig. 2-38). A Safe and Arm (S&A) mechanism on the launch rail is used to restrain the missile, arm, and ignite the Dual-Thrust Rocket Motor.

A canister access port with a removable cover allows the use of a safe only tool to return the S&A mechanism to the safe position.



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Figure 2-38.—Mk 13 Mod 0 VLS canister.

MK 14 MODS 0 & 1 VLS CANISTERS.—The Mk 14 Mods 0 & 1 canisters provide environmental protection, structural and alignment support of the Tomahawk All-Up-Round (AUR) (fig. 2-39). The AUR consists of a missile and booster sealed in a canister that

is nitrogen charged to provide additional environmental protection. The shell structure contains a thermal protective lining to reduce structural temperature during launch. The Mk 14 Mod 1 canister uses a CSES for conventional Tomahawk missiles. The Mk 14 Mod 0

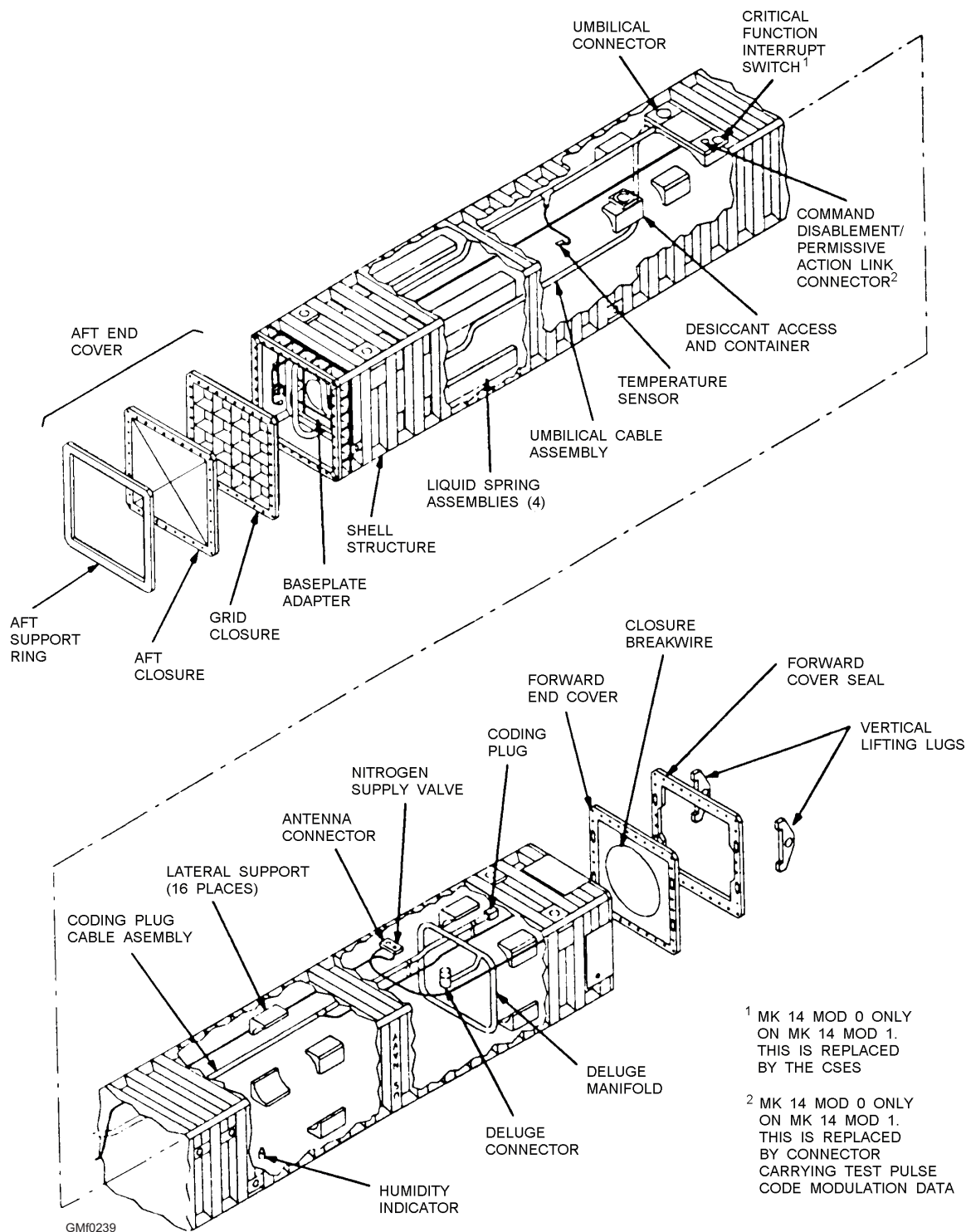


Figure 2-39.—Mk 14 Mods 0 & 1 canisters.

canister uses a Critical Function Interrupt Switch (CFIS) which is similar in function to a CSES, with the exception being that it is key operated to prevent the inadvertent selection and launch of a nuclear missile. A Command Disablement/Permissive Action Link (CD/PAL) connector allows access to the nuclear warhead to unlock the warhead for use.

MK 15 MOD 0 VLS CANISTER.—The Mk 15 Mod 0 canister houses the Anti-Submarine Rocket (ASROC) missile (fig. 2-40). The canister internal and external components are the same as the Mk 13 Mod 0.

MK 19 MOD 0 VLS CANISTER.—The Mk 19 Mod 0 canister is used for missile strikedown

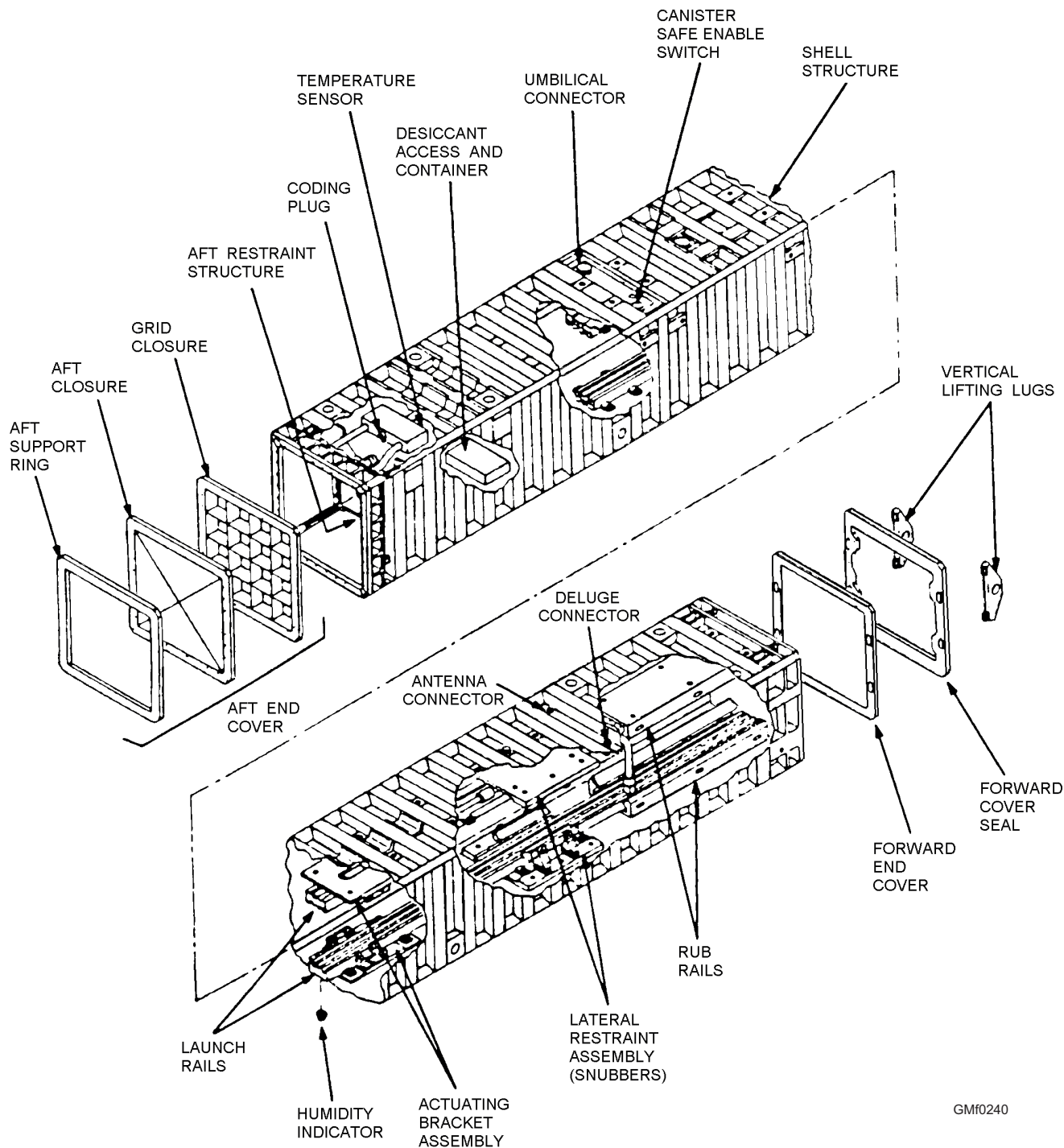


Figure 2-40.—Mk 15 Mod 0 canister.

training (fig. 2-41). The Mk 19 canister is painted blue, rather than the normal white, and stenciled with the word "TRAINING." The canister contains a weighted and balanced beam to simulate a Mk 13

Mod 0 canister. One canister is carried onboard all VLS ships.

MK 21 MOD 0 VLS CANISTER.—The Mk 21 Mod 0 canister houses the SM-2 Block IV, extended

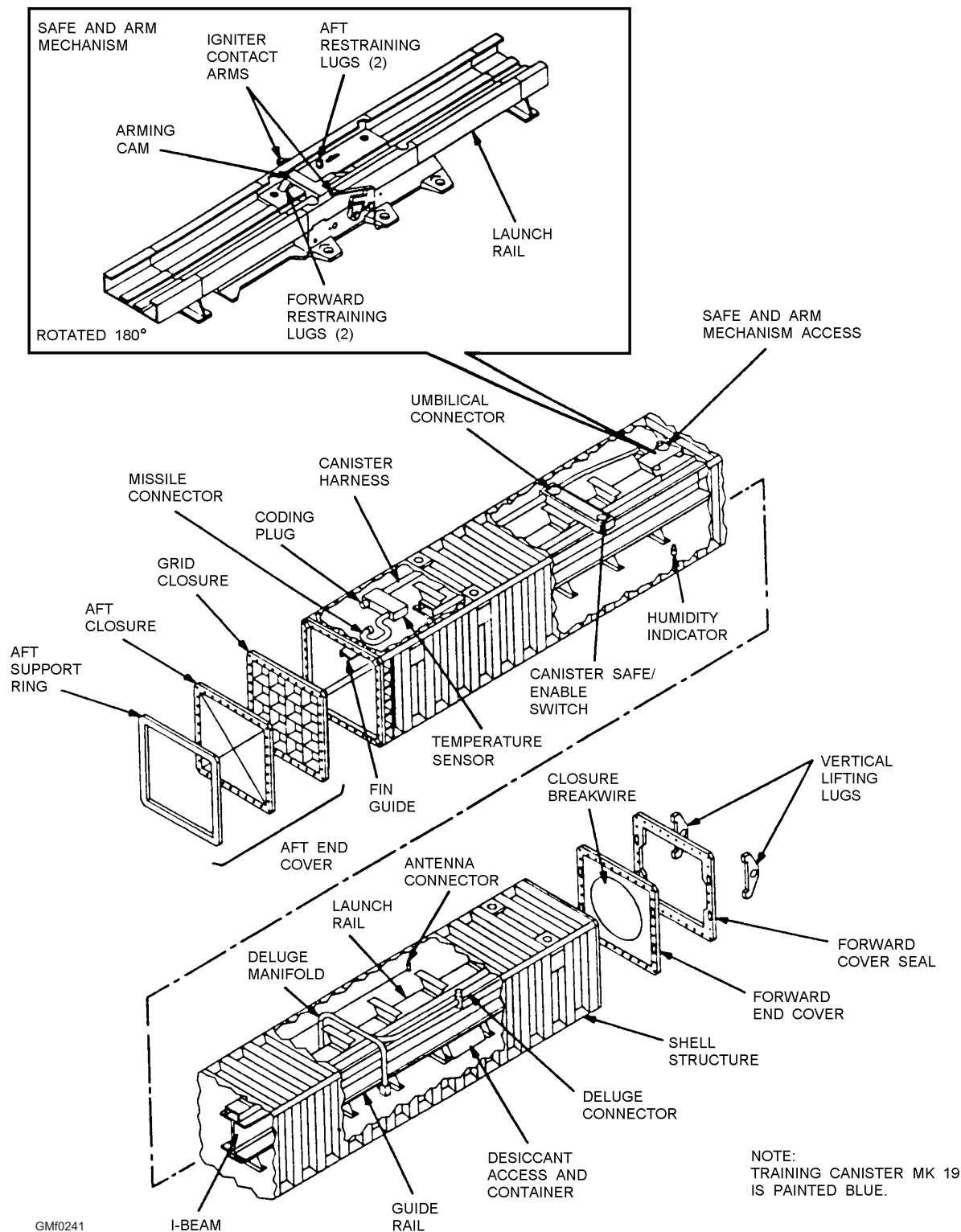


Figure 2-41.—Mk 19 Mod 0 canister.

range (ER) surface-to-air-missile (SAM) (fig. 2-42). Unlike other canisters, this is a single use canister. Dorsal fin flyout guides, booster guide rails, and booster guide cradles provide alignment for the missile during launch. A longitudinal restraint clamp is held secure to the booster until missile launch.

Handling Equipments

We will limit our discussion of the many types of handling equipments to the following items:

1. Handling bands
2. Mk 6 missile transfer dolly
3. Mk 100 guided missile stowage adapter

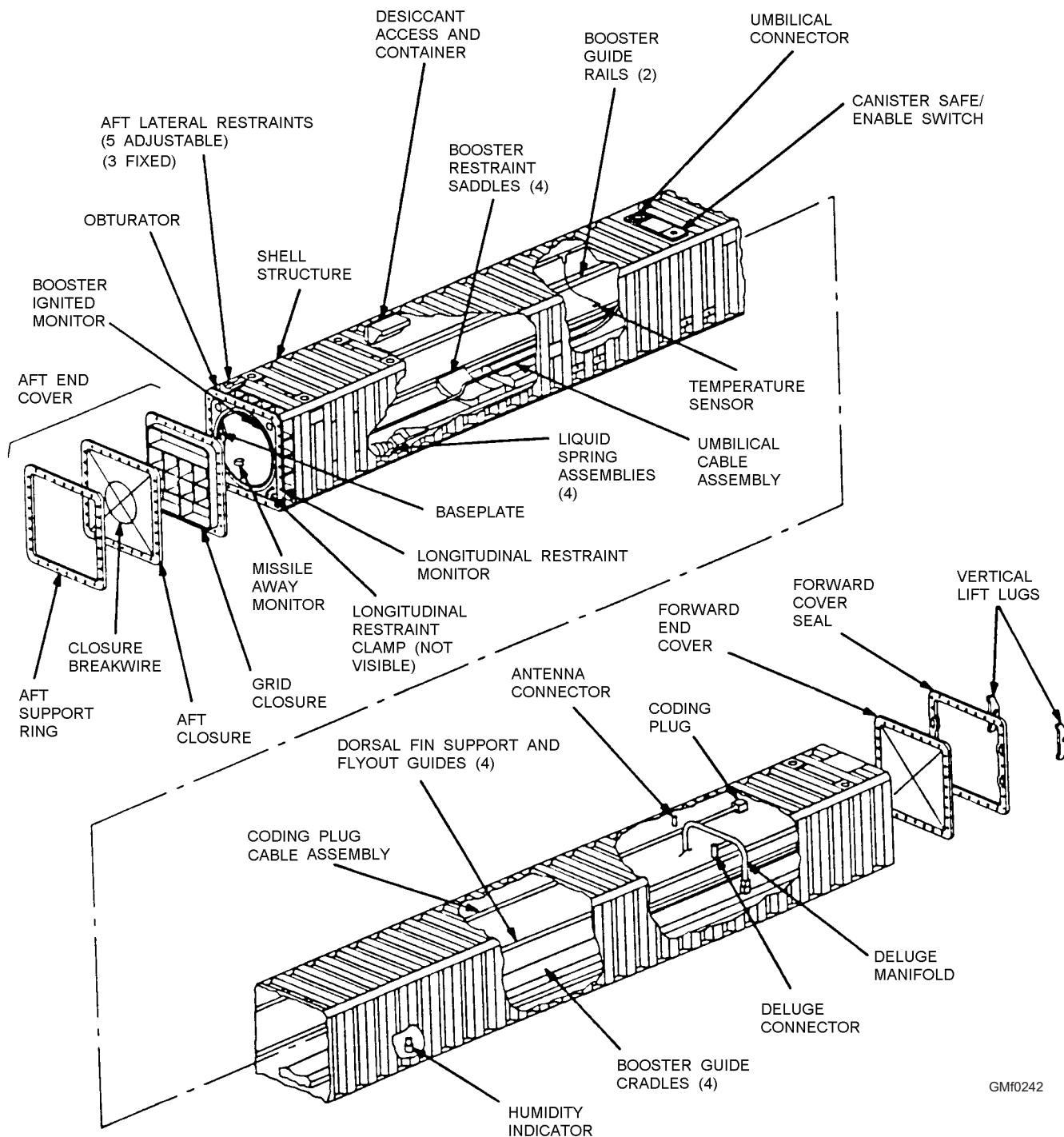


Figure 2-42.—Mk 21 Mod 0 canister.

4. Mk 20 stowage cradle
5. Hoisting beams
6. Mk 8 dolly loading stand
7. Mk 45 handlift truck
8. Forklift trucks; general purpose

As you will soon see, these equipments are very versatile and, in many cases, multipurpose. Certain items are adaptable for handling any type of SMS missile. Each item listed above can be used at sea and ashore.

Be aware that there are numerous regulations governing the safe use of ordnance handling equipment. Any gear used to lift ammunition and explosives must be subjected to rigorous maintenance, inspection, and testing requirements. Equipments that have satisfactorily passed specified weight load tests will be marked to indicate safe working load limits and certification dates. Further details and guidance concerning handling equipment testing and certification are found in *Ammunition Afloat*, NAVSEA OP 4, and *Ammunition Ashore*, NAVSEA OP 5.

HANDLING BANDS.—The Mk 79 Mod 1 missile handling band is used on all Standard missiles (fig. 2-43). The band has a base, two hinged jaws, and a

locking cable. The center of the base (the lower jaw) has a cutout area. This cutout accepts the lower forward and aft launching shoes of the Standard missiles.

After the locking cable is disconnected, the jaws can be opened. The band is installed on the missile and the locking cable is secured again. The dorsal fins of the missile fit within the areas designated as fin slots or fin cutouts.

The VLS canister band Mk 91 Mod 1 (see fig. 2-43) is normally kept onboard destroyer tenders (AD), submarine tenders (AS), and VLS canister supply barge. It is used to steady the canister during strikdown when strikdown is done with the AD/AS or supply barge shipboard crane.

Handling bands have several purposes. They are necessary for all Standard missile handling operations. The bands support and secure these rounds in their shipping containers, their transfer dollies, and their VLS canisters.

MISSILE TRANSFER DOLLY.—The Mk 6 missile transfer dolly is used to transport rounds between supplying and receiving activities. You will also hear them called "grasshoppers."

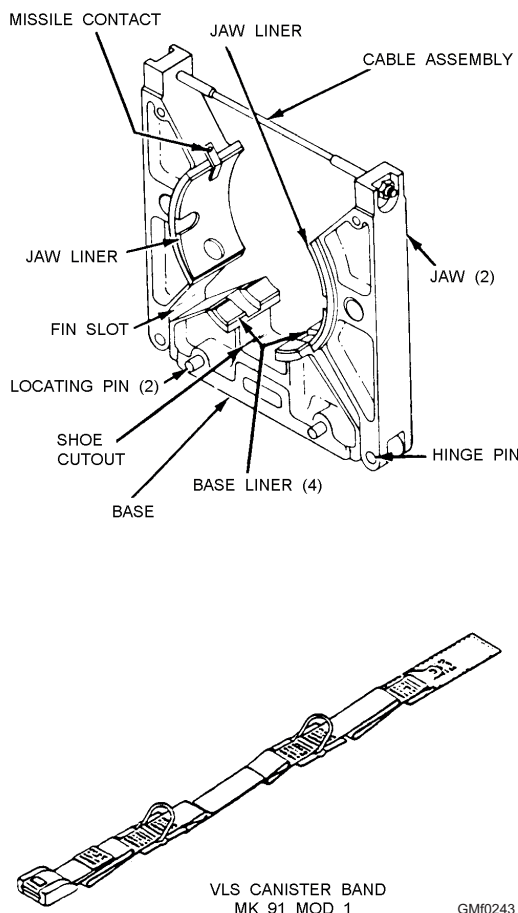


Figure 2-43.—Mk 79 Mod 1 missile handling band and Mk 91 Mod 1 VLS canister handling band.

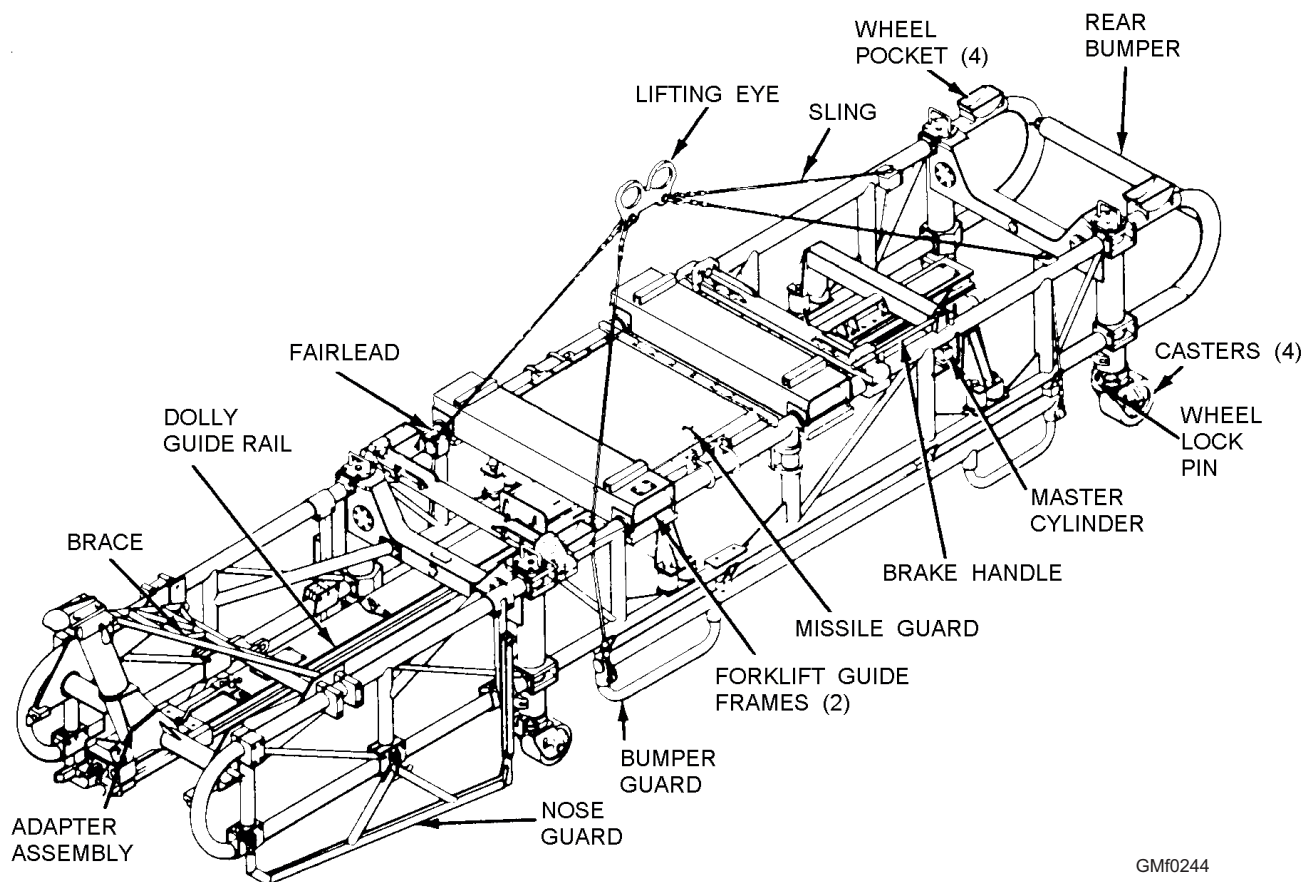
Figure 2-44 shows the Mk 6 Mods 2 and 4 dolly in greater detail. The Mk 6 Mods 2 and 4 dollies are used with Standard and Harpoon missiles. These rounds are secured to and suspended from the inner framework of the dolly by their handling bands.

The Mk 6 dolly incorporates a length of guide rail and an adapter assembly. The guide rail, secured to the inner framework of the dolly, is identical to any Standard GMLS guide rail. A center track or slot accepts a Mk 13 strikedown chain. Forward and aft shoe tracks guide and support the missile by its upper launching shoes. Two openings are cut into the guide rail tracks. These openings permit the missile's shoes to be engaged to or disengaged from the guide rail of the dolly.

The adapter assembly is mounted to the forward end of the framework of the dolly. In its raised position (fig. 2-44), the adapter can connect to the rear of a guide

arm. When the dolly is not in use, the braces of the adapter (arms) can be unpinned. The assembly is then folded to the rear and locked down. With the adapter folded, empty transfer dollies can be stacked on one another. Sometimes the adapter is referred to as a "gooseneck."

The framework consists of welded tubular hardened alloy steel. Four shock-mounted wheel assemblies have manually operated caster locks. The wheels are unlocked whenever the dolly is to be moved from one area to another. Unlocked, the wheels can turn 360° in either direction (similar to the front wheels on a supermarket shopping cart). That eases dolly movement around corners and in tight, limited deck-space areas. The wheels are locked when the dolly is aligned to a guide arm or is over a strikedown hatch. The wheels can be locked only when they are at 0° or 180°. The dolly can still be rolled, but only in a straight line (forward or backward).



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Figure 2-44.—Mk 6 Mods 2 & 4 missile transfer dolly.

The dolly has a hydraulically actuated disc-brake system. The brakes are controlled by a manually operated deadman-type brake handle. The handle must be pumped a few times (which builds up hydraulic pressure) to release the brakes. If you are the brakeman on a dolly, please be careful. Releasing the brake handle automatically sets the brakes and Mk 6 dollies will "stop on a dime"! This action not only "surprises" your shipmates, but jars/jolts the missile quite a bit. Release the handle slowly to stop slowly.

A four-legged sling provides a means to hoist the dolly by crane. The sling also actuates the hinged side-mounted bumper guards that protect the center of the missile. Nose guards and a rear bumper provide additional protection. Clear plastic guards keep an unused sling from hitting the missile.

Two forklift guide frames, or channels, are installed on the dolly. Wheel pockets on the top framework permit empty dollies to be stacked in stowage. Loaded dollies must not be stacked. Also, never leave a missile in a dolly any longer than necessary. One other word of warning—watch your toes! Transfer dollies are heavy, cumbersome vehicles. If one runs over your foot, you WILL understand the true meaning of pain.

GUIDED MISSILE STOWAGE ADAPTER.—

The Mk 100 guided missile stowage adapter is shown in figure 2-45. It is a simple aluminum alloy weldment that fits along the top and bottom of a handling band. The adapter adds support to the bands when missiles are stacked as shown in the figure. The Mk 100 stowage adapter is normally used when Mk 20 stowage cradles are not available.

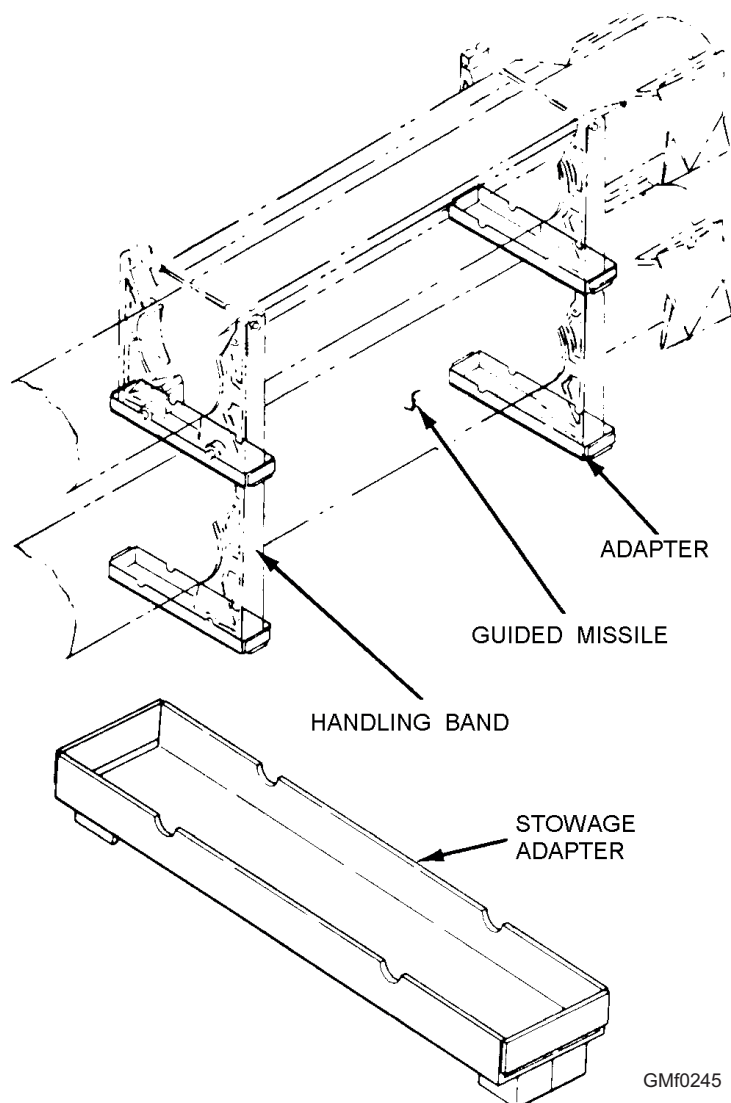


Figure 2-45.—Mk 100 guided missile stowage adapter.

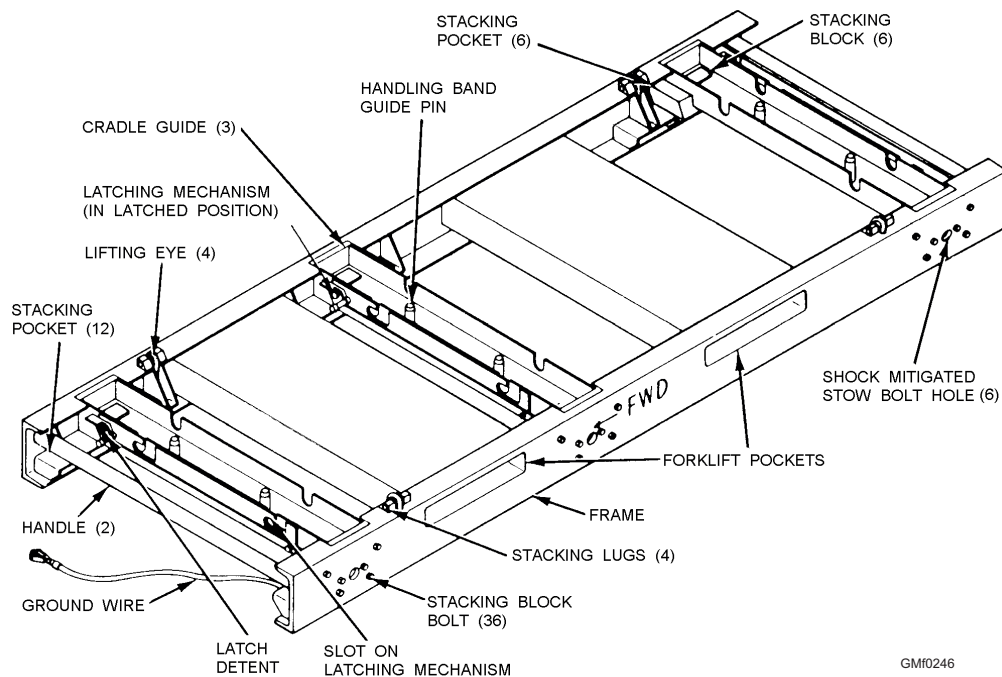


Figure 2-46.—Mk 20 stowage cradle.

STOWAGE CRADLE.—The Mk 20 stowage cradle is shown in figure 2-46. It is a welded aluminum frame with four lifting eyes and two forklift pockets. Three cradle guides accept and lock the Mk 79 handling bands in place. Stacking pockets are provided on the bottom of the side rails (frame) of the cradle.

Figure 2-47 illustrates various missile stacking arrangements using a Mk 20 cradle. (Three rounds high

is the limit.) The cradle can also be used to load/unload a Mk 6 transfer dolly if a forklift truck is available.

HOISTING BEAMS.—Figure 2-48 shows two common hoisting beams. These devices are often called handling beams or strongbacks. Generally, a hoisting beam attaches to the shoes of the round or to its handling bands. The round can then be lifted out of its

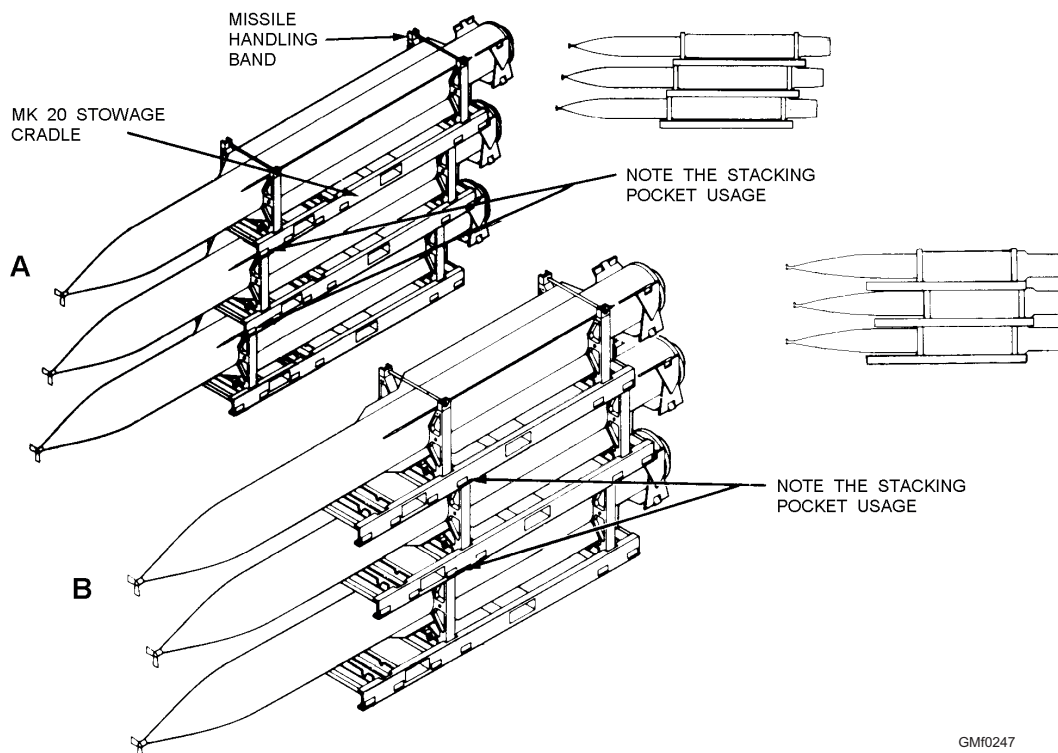


Figure 2-47.—Stacking configurations available with the Mk 20 stowage cradle: A. Staggered-aft method; B. Alternate staggering method.

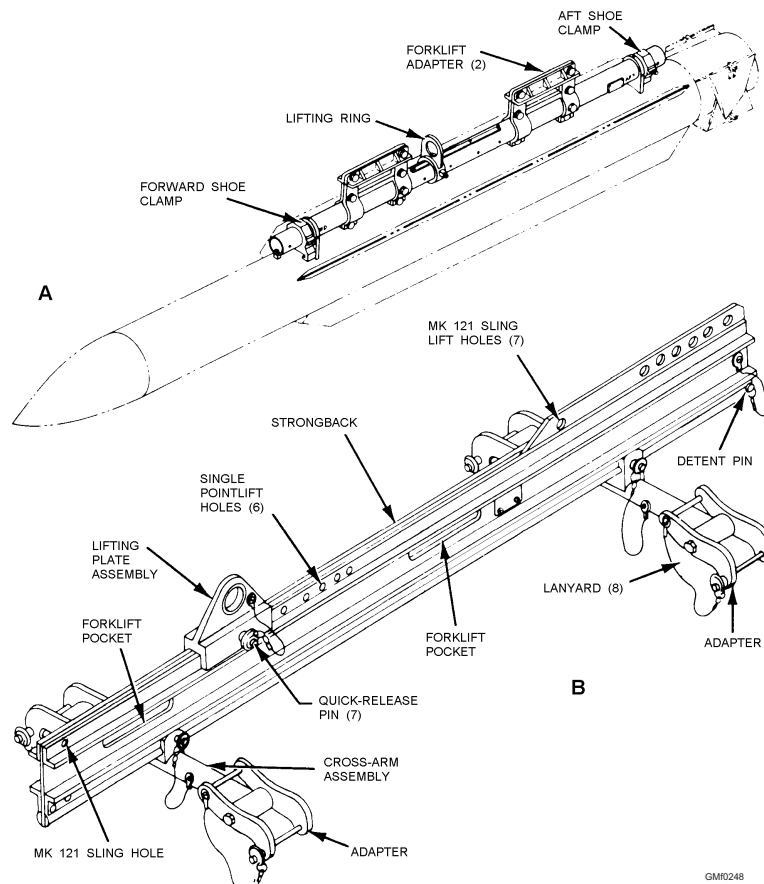


Figure 2-48.—View A. A Mk 5 hoisting beam attached to a missile; View B. A Mk 15 hoisting beam.

shipping container by a forklift, truck, or crane. The missile is then transferred to a Mk 20 stowage cradle or a dolly loading stand. Of course, this sequence can be reversed to reload a container.

The Mk 5 hoisting beam (fig. 2-48, view A) handles Standard missiles. It is manually connected to the shoes of the missile. The two shoe clamps slide over the upper shoes of the round.

The Mk 15 hoisting beam (fig. 2-48, view B) can be adjusted to handle all rounds. Instead of clamping to the missile shoes, it attaches to the Mk 79 handling bands. The adapters and cross-arm assemblies can be adjusted to different load lengths. The lifting plate assembly can also be moved to obtain the correct center of gravity for different loads.

DOLLY LOADING STAND.—The Mk 8 dolly loading stand is shown in figure 2-49. It is adaptable for

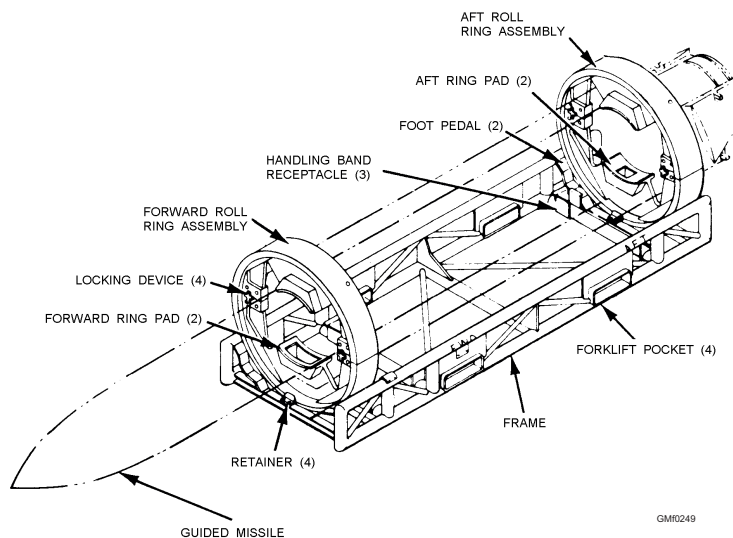


Figure 2-49.—Mk 8 dolly loading stand.

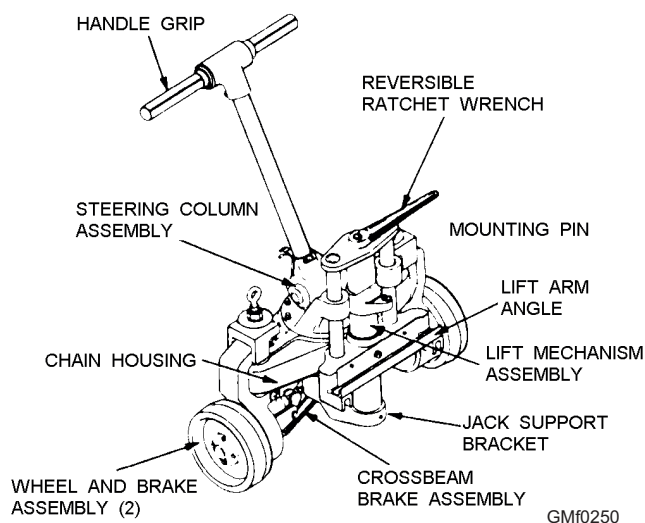


Figure 2-50.—Mk 45 Mod 1 handlift truck.

Standard missiles. The stand is used to load/unload a Mk 6 transfer dolly. You might also hear the Mk 8 loading stand called a roll stand or (simply) a load stand.

The stand is a braced, tubular aluminum frame. Two roll ring assemblies are mounted near the ends of the frame. Each ring assembly consists of two separate and removable sections or halves. A ring-locking mechanism is part of each roll ring assembly. Normally, the locking mechanism is engaged and prevents the ring assembly from rotating. Depressing a foot pedal (not shown in the figure) disengages the lock mechanism. The roll ring assembly is then free to be turned. The frame also mounts three pairs of handling band saddles and has a pair of forklift truck pockets.

When handling Standard missiles, the top roll ring halves must be removed. The forward and aft missile

shoes are guided into and supported by shoe pockets in the lower ring halves. Handling bands are not required in this type of handling operation.

The stand also provides a means to rotate Standard missiles. Once a missile is loaded into the lower ring halves, the top ring halves are reinstalled and clamped. Depressing the foot pedals unlocks the roll ring assemblies and the missile can be rotated/rolled. A missile may be rolled to ease minor maintenance actions also.

HANDLIFT TRUCKS.—The Mk 45 Mod 1 handlift truck is shown in figure 2-50. Two handlift trucks can be used to move loaded/unloaded shipping containers and stowage cradles. Figure 2-51 illustrates handling of a Mk 372 container. Two people must synchronize their efforts during steering maneuvers. They must also provide the "horsepower" to move the load.

The truck consists of an aluminum body, a steel steering post, and a lift mechanism. A reversible ratchet is operated to raise/lower the lift mechanism manually. The mechanism has a mounting pin and a lift-arm angle to engage the load.

The truck is guided by moving the steering post (or tow bar). Steering may be accomplished with the post in either a horizontal or "latched up" (near vertical) position. The wheel brakes must be released to permit steering. Each wheel has its own brake assembly. Both assemblies are controlled through a common linkage connected to the handle grips. The brakes release when the handle grips are rotated and held at their full forward position.

The lifting surface of the truck is its single lift-arm angle. The angle engages a bracket on a container, cradle, skid, or special adapter device. The mounting pin serves as a guide pin. It engages a recess on Mk 183

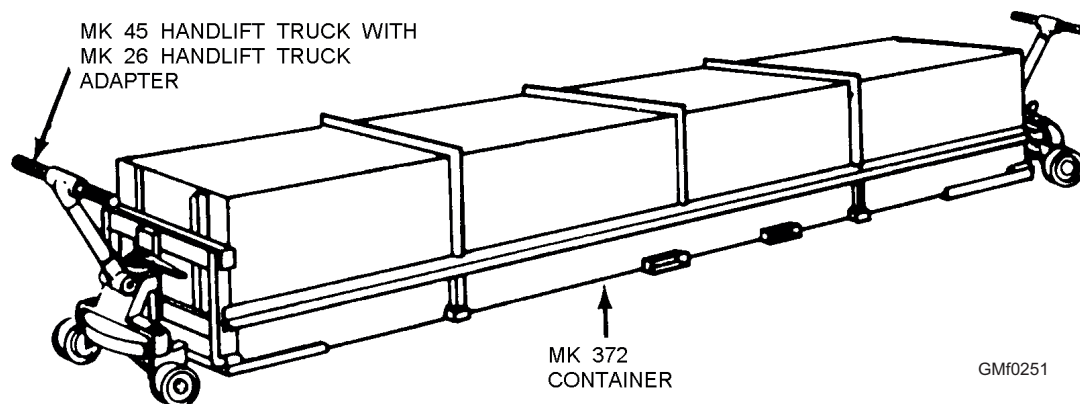


Figure 2-51.—Handling a Mk 372 container with Mk 45 handlift trucks with Mk 26 handlift truck adapters.

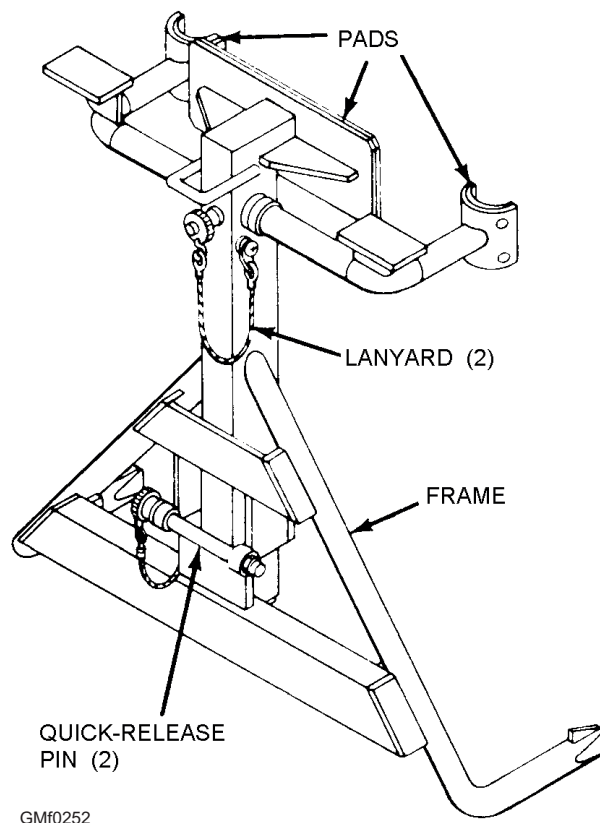


Figure 2-52.—Mk 26 Mod 2 handlift truck adapter.

ASROC containers (only). The pin is not a lifting surface. The ratchet handle will raise/lower the lift arm about 8 inches.

A Mk 26 Mod 2 handlift truck adapter (fig. 2-52) can be attached to the front of the Mk 45 handlift truck. The adapter makes the handlift truck compatible with various container loads. Pads prevent metal-to-metal contact between the adapter and a container. Two lower arms fit into the lifting or handling eyes of the various

containers described earlier. The Mk 372 and Mk 632 containers can be moved using two handlift trucks with adapters.

The Mk 160 Mods 0 and 1 handlift truck adapters (fig. 2-53) are used to handle Mk 13, Mk 15, and Mk 19 VLS canisters. It also empties canisters Mk 14 and Mk 21. The handlift truck adapter attaches to the handlift truck; two handlift trucks with adapters are required to move a canister.

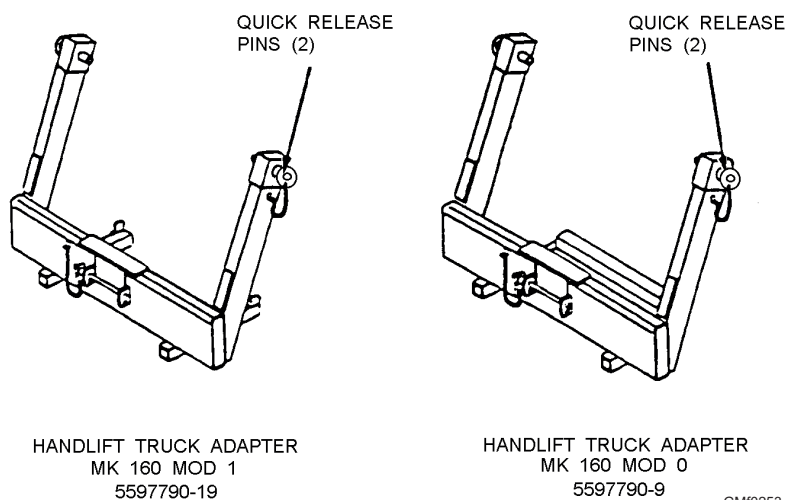


Figure 2-53.—Mk 160 Mods 0 & 1 VLS handlift truck adapters.

FORKLIFT TRUCK.—A forklift truck (fig. 2-54) is a mobile three- or four-wheel automotive unit. It enables one individual to pick up a load, transport, and lift it to various heights. The truck is designed on the cantilever principle. The load is counterbalanced by the weight of the truck in back of the center of the front wheels. The front wheels act as the fulcrum or center of balance.

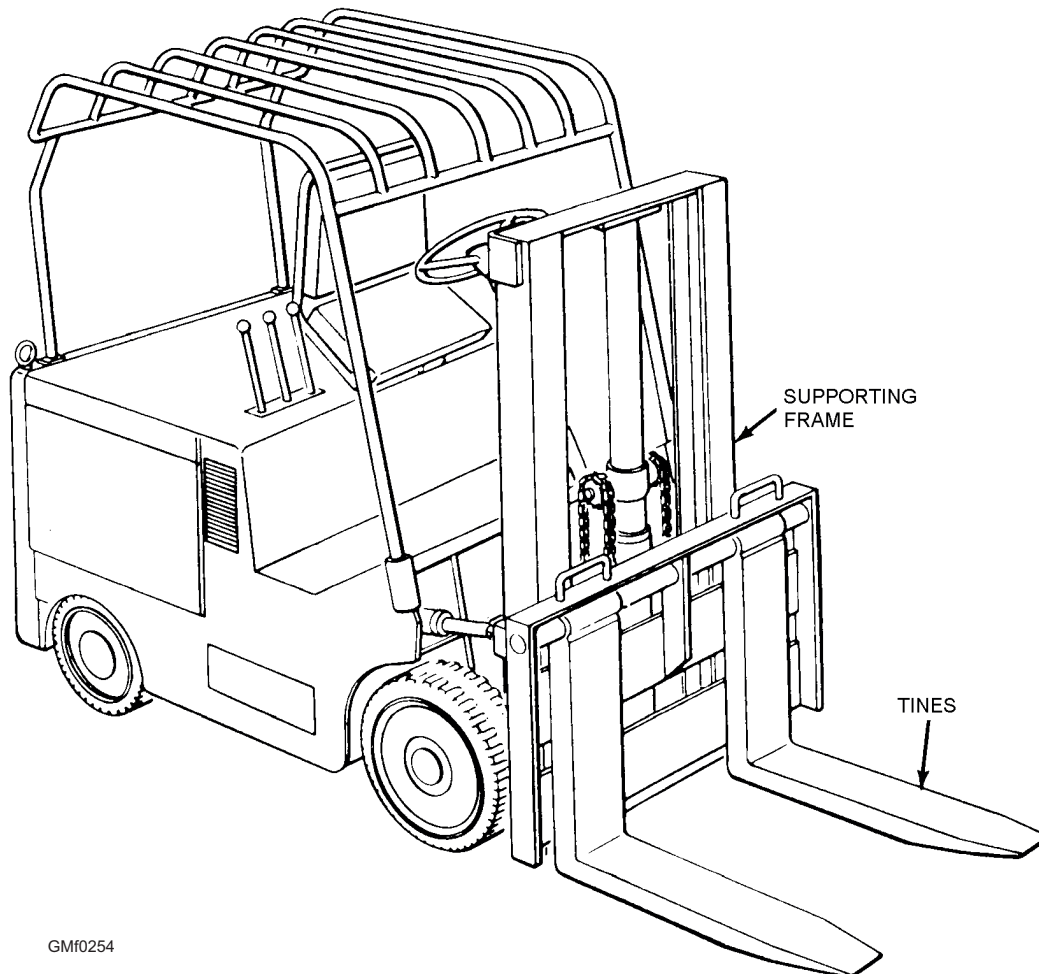
The truck has a two-tine fork which is secured to the supporting frame. The tines can be moved vertically, frontward and backward, or tilted by a mechanical or hydraulic lift. This flexibility aids in picking up and balancing the load.

Forklift trucks used to handle ordnance may be powered by diesel engines or by a battery-powered electric motor. A mechanical or hydraulic braking system can be used. The steering system may be an automobile- or lever-type mechanism. Pneumatic tires are provided for use over rough and uneven terrains. They are also used in muddy or soft, sandy ground. Solid rubber, cushion-type tires are used over smooth and hard surfaces. These areas include paved roads, magazine and warehouse floors, and pier areas.

Battery-electric forklift trucks are either spark-enclosed or explosion-proofed. They provide safe operation in atmospheres with explosive mixtures of air and flammable gases, vapors, or dust. Spark-enclosed trucks ensure that no flame or sparks from arcing generators, motors, or switches escape to the atmosphere. Explosion-proof trucks are of a heavy steel, fully enclosed construction. They are designed to contain an internal explosion completely. Additionally, a constant flow of air is forced over the stowage batteries to dilute/diffuse any emitted battery gases. The exhaust systems of diesel-powered trucks have spark-arresting devices. This device permits safe operation in areas where exhaust sparks could be a danger.

The capacity of a forklift truck is its most important characteristic. It governs the maximum weight of a load that can be counterbalanced safely. Other important characteristics include such items as maximum lift height, minimum turning radius, range of tilt, and travel speeds.

In missile-handling operations, a forklift truck is an extremely important and necessary piece of equipment.



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Figure 2-54.—Typical front-loading forklift truck.

Only trained and qualified personnel are permitted to drive forklift trucks.

Handling Operations

Now that you have some background information on various containers and handling equipments, let's put it to use. The next three figures in the text illustrate certain basic handling operations for Mk 13 Mod 4 and Mk 26 GMLS class ships. Refer to them frequently as we describe the major events. Take special note of the equipments being used. Also, use a bit of imagination and remember the versatility of these items.

NOTE

Certain key steps or events have purposely been omitted from the general descriptions that follow.

TARTAR HANDLING-CONTAINER TO DOLLY.—Figure 2-55 shows a typical Standard handling sequence. In this case, the missile is transferred directly from its container onto a dolly.

Figure 2-55, view A shows a forklift truck moving a Mk 372 container to a designated handling area. Note that the forklift tines are lowered and the container rides

near ground level. This orientation is the safe way, considering center of gravity and counterbalance factors. The forklift will deposit the container on a flat, even surface (either on a pier or AE-type ship's deck).

Figure 2-55, view B shows the container being prepared. The lid is unlatched, lifted from the base, and hand-carried from the immediate loading area. That makes room for upcoming forklift and dolly movements. The center missile support (U-frame) is removed. The lower missile shoes are unlocked from the inner support assembly of the container.

In (fig. 2-55, view C), a Mk 6 Mod 2 or 4 dolly has been brought into position behind the container. When the dolly is aligned to the container, its wheels are locked (straight). The dolly is pushed forward over the container until the guide rail openings of the dolly are over the upper missile shoes. At this point, the missile shoes are about 9 inches below the guide rail of the dolly.

In (fig. 2-55, view D), the forklift truck has reengaged the container. Carefully, the container is raised until the missile shoes enter the guide rail openings of the dolly. The dolly is pushed so the shoes enter the guide rail tracks/slots. Locking mechanisms are turned to secure the missile in the dolly. The forklift

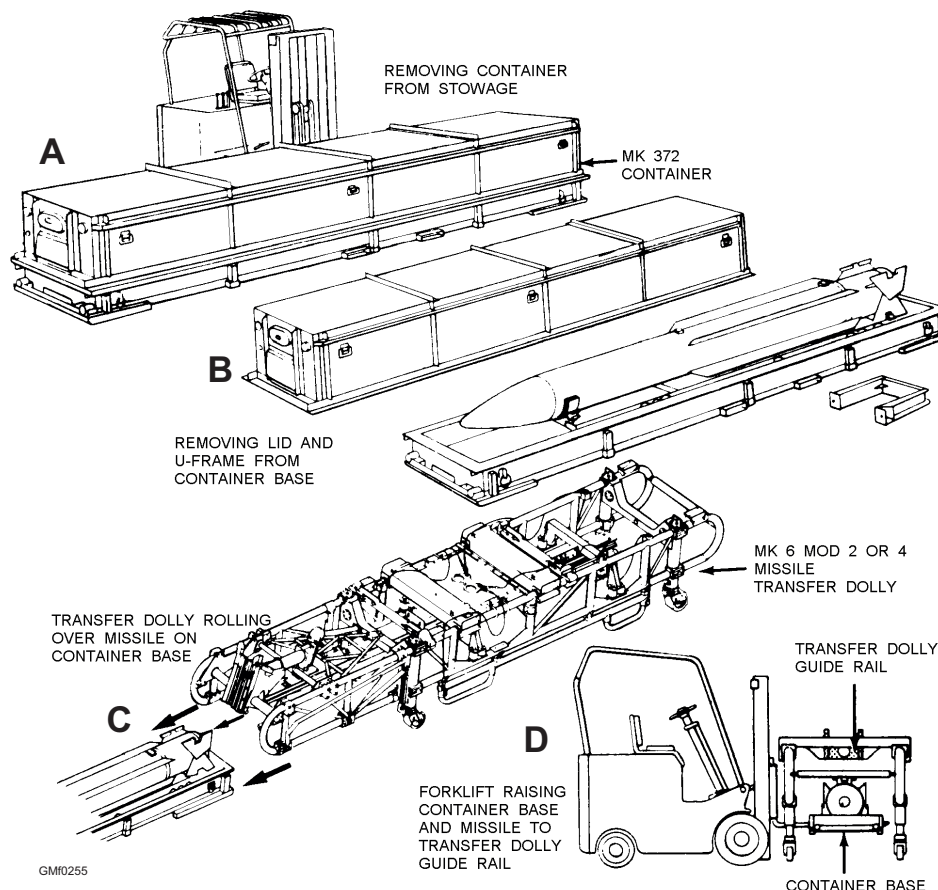


Figure 2-55.—A Standard MR missile handling sequence; container to dolly without roll.

operator lowers the empty container to the ground (pier or deck). The forklift backs away and the loaded dolly is pushed to a staging area. The lid of the container is reinstalled and the empty container is removed from the area.

The procedures described above pertain to an on-load operation. An off-load sequence is essentially the reverse—the missile is transferred from a dolly directly into a container.

STANDARD HANDLING: ROLLING THE MISSILE.—In certain situations, a Standard missile must be rolled or turned 180°. Figure 2-56 illustrates the key steps in this operation.

In (fig. 2-56, view A), a Mk 5 hoisting beam has been attached to the missile shoes. After the missile is unlocked from the container, a forklift carefully raises the loaded beam clear of the base of the container. This operation is often called *decanning*.

Figure 2-56, view B shows the missile being lowered into a properly prepared Mk 8 dolly loading stand. When the upper ring halves of the roll ring assembly are resecured in place, the missile is rolled.

Figure 2-56, view C shows the dolly in position to be pushed over the load stand. (The upper ring halves are removed again.) This operation is the same as that described with view C of figure 2-55.

In (fig. 2-56, view D), the forklift is raising the loading stand to engage the missile to the dolly. Again, the operation is similar to view D in figure 2-55.

Now use your imagination. The Mk 5 hoisting beam in view A of figure 2-56 could be replaced with a Mk 15 beam; that is, if Mk 79 handling bands were installed on the missile. Also, in (fig 2-56, view A), the container could be substituted with Mk 100 stowage adapters or a Mk 20 stowage cradle. (Do you get the idea of the "imagining" exercise?) In view B of figure 2-56, the load stand could be a Mk 20 cradle instead. The operations in views C and D of figure 2-56 would be the same using a cradle. In certain sequences, even the forklift truck can be replaced with an overhead crane/hoist.

Again, handling equipments are very versatile. The conditions of the handling operation will dictate which equipments (or options) can be used.

REPLENISHMENT METHODS

Earlier in the text, we briefly touched upon the subject of replenishment. (Refer to chapter 8's

struckdown section.) We learned there were various methods used to transfer missiles between two activities. These methods included UNREP-CONREP, VERTREPs, and pierside and lighter operations using a crane. The following areas of the text describe these methods in more detail. Essentially, we'll see how a transfer dolly (or container) is delivered to a combatant ship.

Experience and on-the-job training are the best teachers in replenishment operations. However, you should have a general understanding of how the different evolutions are performed. You must also realize that any replenishment is (1) a team effort and (2) a dangerous operation. All personnel involved in a replenishment must work quickly, quietly, and efficiently. Cooperation is the key ingredient.

Usually, Gunner's Mates are not directly responsible for setting up and running a replenishment. However, we may be required to assist in preparing for a replenishment (e.g., as line handlers). The ship's Boatswain's Mates normally set up and run the transfer (CONREP) rigs between ships. They will also direct a helicopter (helo) during VERTREPs. At an NWS or other pier facility, civilian workers will operate and direct a crane. These personnel are trained to do this kind of work.

Our primary job is to move the missile between the replenishment station and the GMLS's strike-down area. A coordinated team effort by handling personnel is vital in this case. Transfer dollies or containers must be moved safely and smartly. That is important in contributing to the overall smoothness of the operation.

Any ammunition transfer is a hazardous evolution considering the quantity of high explosives involved. Protective gear, such as safety helmets (hardhats), steel-toed safety shoes, and lifejackets (at sea), must be worn. Rings, watches, cigarette lighters/matches, and so forth, must not be brought to a replenishment area. Be careful and cautious. Obey the rules and don't rush in your work.

UNREP-CONREP

The most common underway-connected replenishment (UNREP-CONREP) method for missile transfer today is called STREAM. STREAM stands for standard tensioned replenishment alongside method. It is used to transfer a variety of missile, ammunition, and other cargo loads.

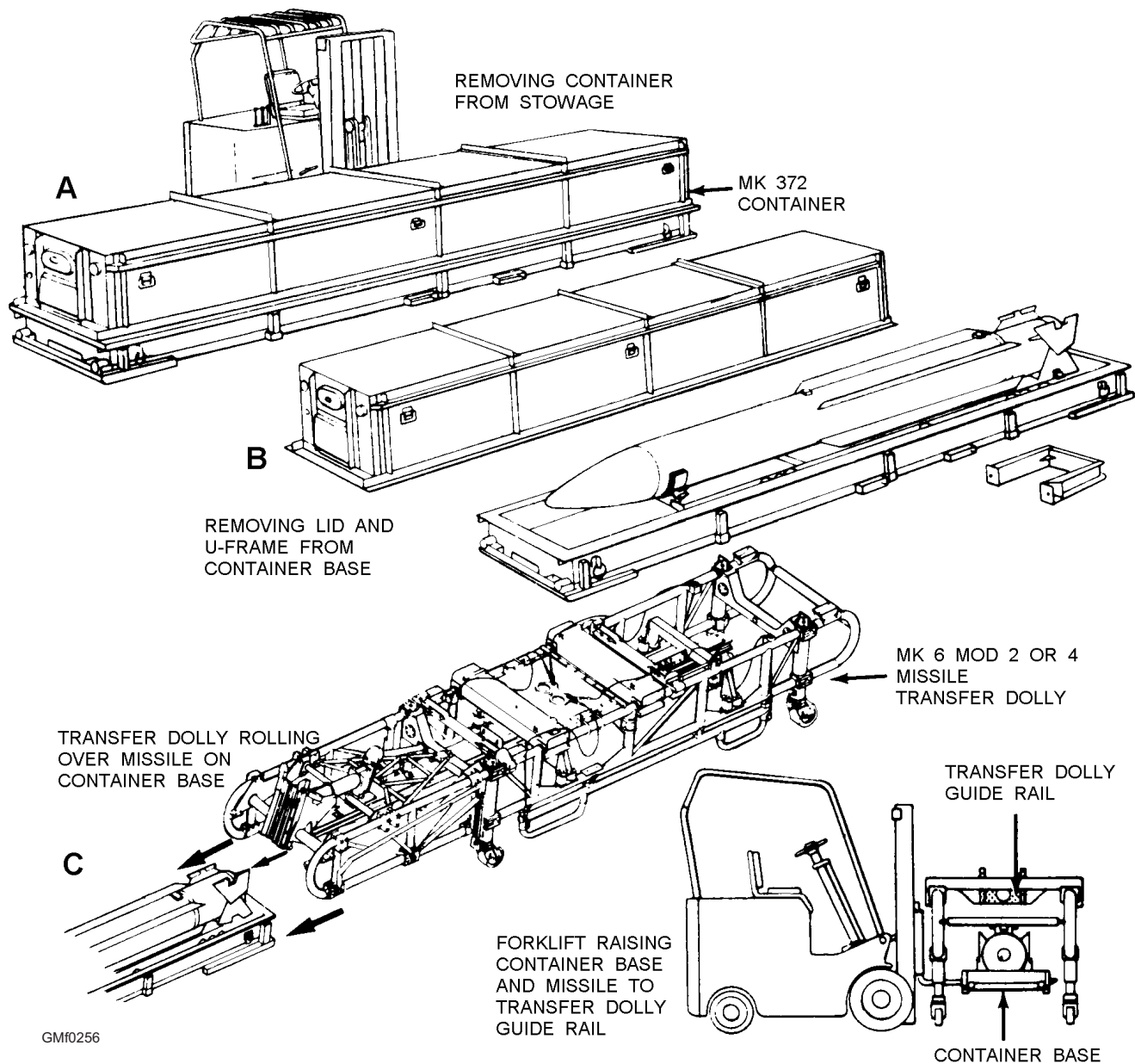


Figure 2-56.—A Standard MR missile handling sequence; container to loading stand to dolly roll.

Figure 2-57 illustrates the basic arrangement for a STREAM rig. After the various lines are connected, the sending ship controls all operations. In the figure, the receiving ship is using a sliding pad eye. As the load reaches the receiving ship, the pad eye is lowered. This lowering places the transfer dolly on deck at the replenishment station. The sling of the dolly is disconnected from the cargo hook. The handling crew moves the dolly to the GMLS's strikedown area. Strikedown operations are performed and the empty dolly is returned to the replenishment station.

Additional information about CONREP procedures can be found in *Naval Warfare Publication (NWP) 14, Replenishment at Sea*. Another good (and available) source is *Boatswain's Mate*, volume 2, NAVEDTRA 12102.

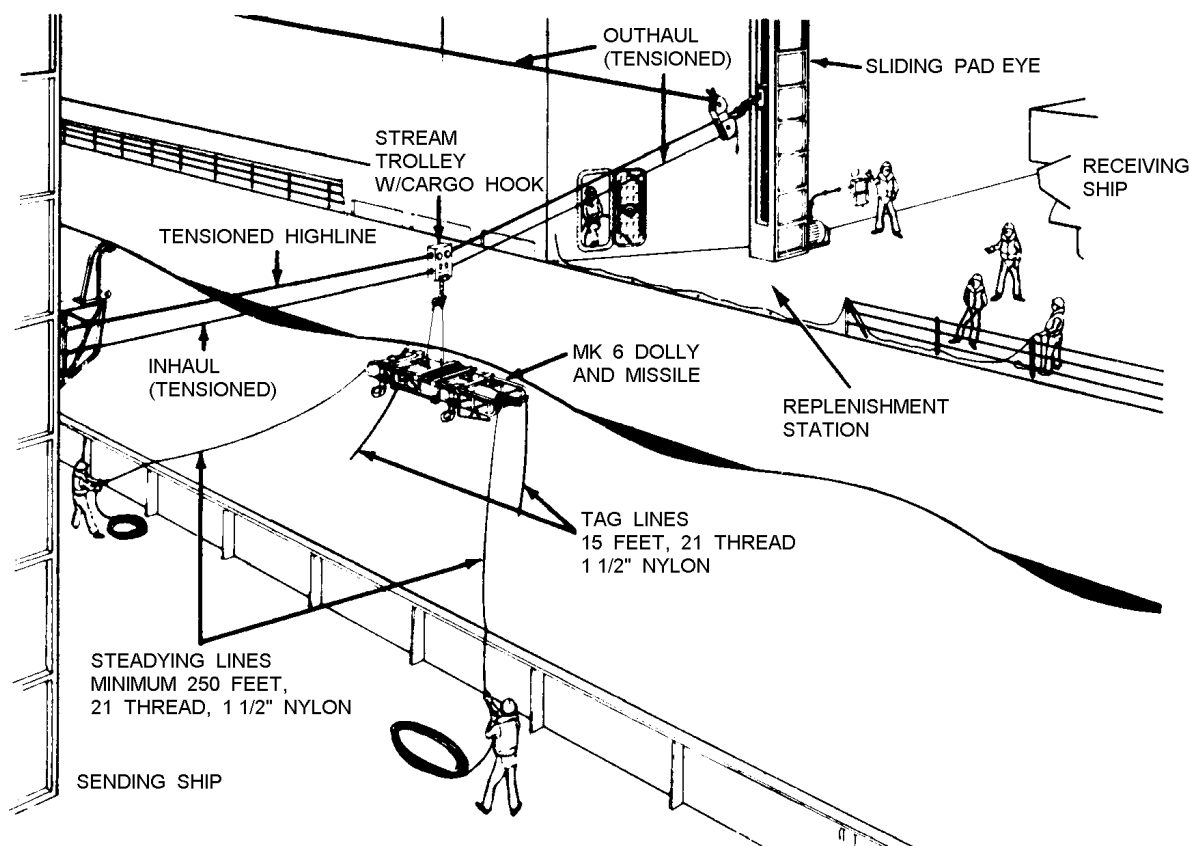
VERTREP

A vertical replenishment (VERTREP) is a very efficient and versatile replenishing method. A helicopter (helo) is used to transfer just about anything

anywhere. Ammunition, cargo, and personnel loads can be transported between ships, ship-to-shore, or shore-to-ship. The only limiting factors to a helo operation are the range and capacity of the helo, and the weather. If the receiving ship is equipped with the proper (and required) lighting, nighttime operations are possible. However, most VERTREP ammunition transfers are conducted during daylight hours (for safety considerations).

During a missile transfer, the helo supports the load (a transfer dolly or container) on a cable/sling arrangement. As the helo approaches the receiving ship, the pilot maneuvers over the "drop" zone of the ship. A landing signalman (usually one of the ships BMs) guides the helo in with a series of hand signals. When the load is over the drop zone, the helo lowers and puts the dolly/container on deck. A hookup man (another ships BM) runs to the load and disconnects the helo's hook. The helo rises and clears the area.

When the helo is at a safe distance from the ship, the missile-handling team assembles. The team moves



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Figure 2-57.—Missile transfer by STREAM.

the dolly or container to the GMLS's strikedown area. On-load (or off-load) operations are performed and the dolly/container is returned to the drop zone. The helo comes back and picks up the load. One missile VERTREP has been completed.

VERTREP is probably the most popular replenishing method today. It has many advantages, such as speed and simplicity. However, from a Gunner's Mate's point of view, two words of caution. First, any helo operation is considered a dangerous operation. Only the landing signalman and hookup man are permitted in the drop zone area while the helo is overhead. All other personnel must remain well clear of the area at this time. Foreign object damage (FOD) is another danger. Rotor blade suction will draw ANY loose objects into the engine of the helo with disastrous results. Do not wear hats (ball caps) and ensure all gear near the helo area is firmly secured.

The second word of caution applies to the load. Be sure to inspect the missile very carefully as soon as the helo clears the ship. Why do you think the helo area is called a "drop" zone? The missile can sustain some

rather severe damage (shocks, bounces, jolts) as it "hits" the deck. If the damage is obvious (e.g., a cracked radome), reject the round before it is moved. Also, check the transfer dolly for damage caused by hard hits on deck. Look at the dolly wheels carefully.

DOCKSIDE REPLENISHMENT

A typical dockside (or pierside) replenishment operation is illustrated in figure 2-58. The major handling equipments and events have already been described. (See figs. 2-55 and 2-56, for example). Any changes or variations to the basic steps in figure 2-58 are minor. For instance, missiles may arrive on the pier in a boxcar instead of on a flatcar. Sometimes a flatbed truck is used.

Quite often during dockside replenishment, the receiving ship is required to supply personnel to assist the pier crew. As a Gunner's Mate, you may get this assignment. You'll actually get the chance to work with the different types of handling equipments we've discussed.

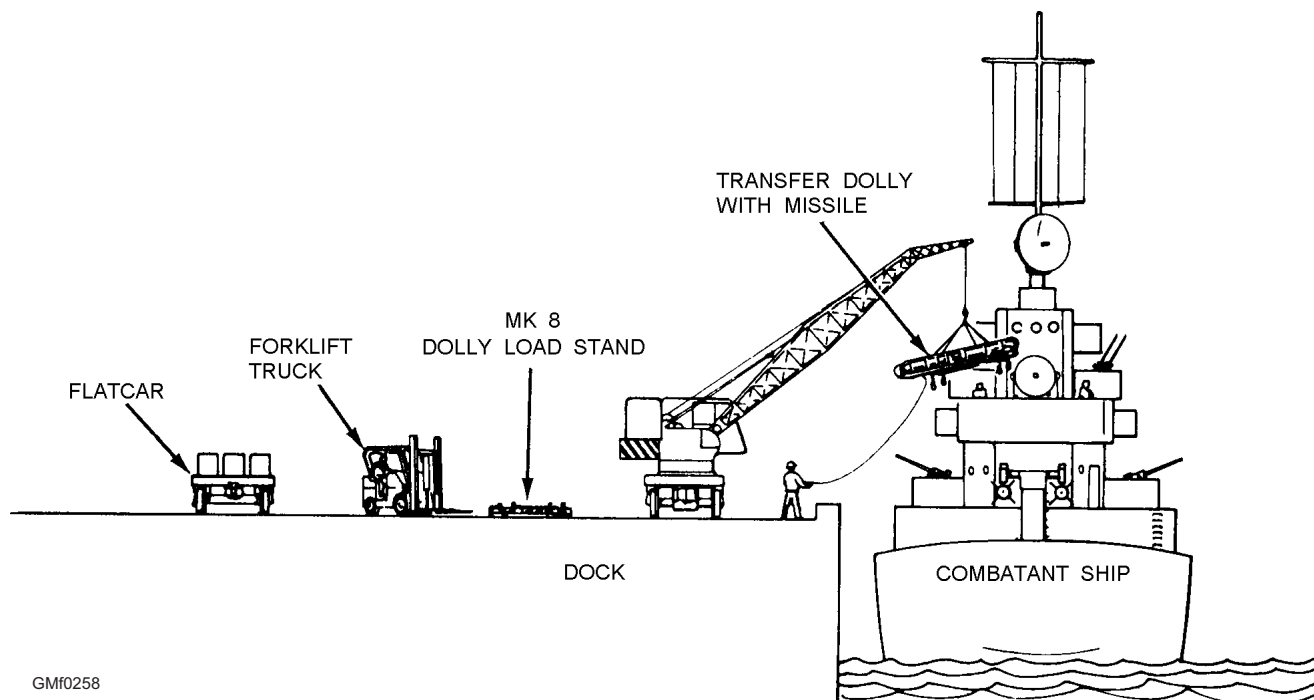


Figure 2-58.—Dockside replenishment.

LIGHTER REPLENISHMENT

A lighter is a specially constructed barge designed to carry ammunition. A typical lighter replenishment is seen in figure 2-59. The receiving ship in the figure is a combatant. However, lighter replenishment is also performed with AE-type ships.

The handling operations that take place on a lighter are the same as on a pier or AE-type ship. These operations include canning/decanning, dolly loading/unloading, rolling a missile, and so forth.

Lighter replenishment is used for various reasons. Its main advantages are in time and money savings. It is cheaper and quicker to load a lighter at an NWS and deliver the missiles/ammunition to a ship. The ship does not have to get under way and that is a huge savings in fuel costs. Another point is that newer AE-type ships are deep draft vessels. They cannot always navigate the rivers and channels leading to an NWS dock. Therefore, the lighter replenishment method is gaining in popularity. Many times the lighter and receiving ship will meet halfway and conduct the ammunition transfer while at an anchorage.

This concludes our discussion of missile-handling operations. For the most part, these events occur ashore at an NWS. However, with the exception of assembling and testing, AE-type ships perform the same jobs. Our next subject area deals with the missiles after they are safely stowed aboard a combatant ship.

MISSILES ABOARD SHIP

LEARNING OBJECTIVE: Recall information concerning handling, stowing, inspecting, and cleaning and preservation of missiles aboard ship.

Guided missiles are delivered to the fleet in an all-up-round (AUR) status. All tests and certification checks are performed before the missile leaves the NWS. Aboard ship, we are not authorized nor equipped to disassemble, test, or repair any critical missile component.

Aboard ship, our current activities with missiles can be summarized as follows:

1. Handling
2. Stowage
3. Inspections
4. Cleaning and preservation

HANDLING

You will be responsible for the safe and proper handling of missiles at all times. Obviously, this point strongly applies to replenishing and strikedown operations. During these periods, the missile has minimum protection with maximum exposure.

However, do not forget launcher loading, unloading, and intersystem transfer operations. These

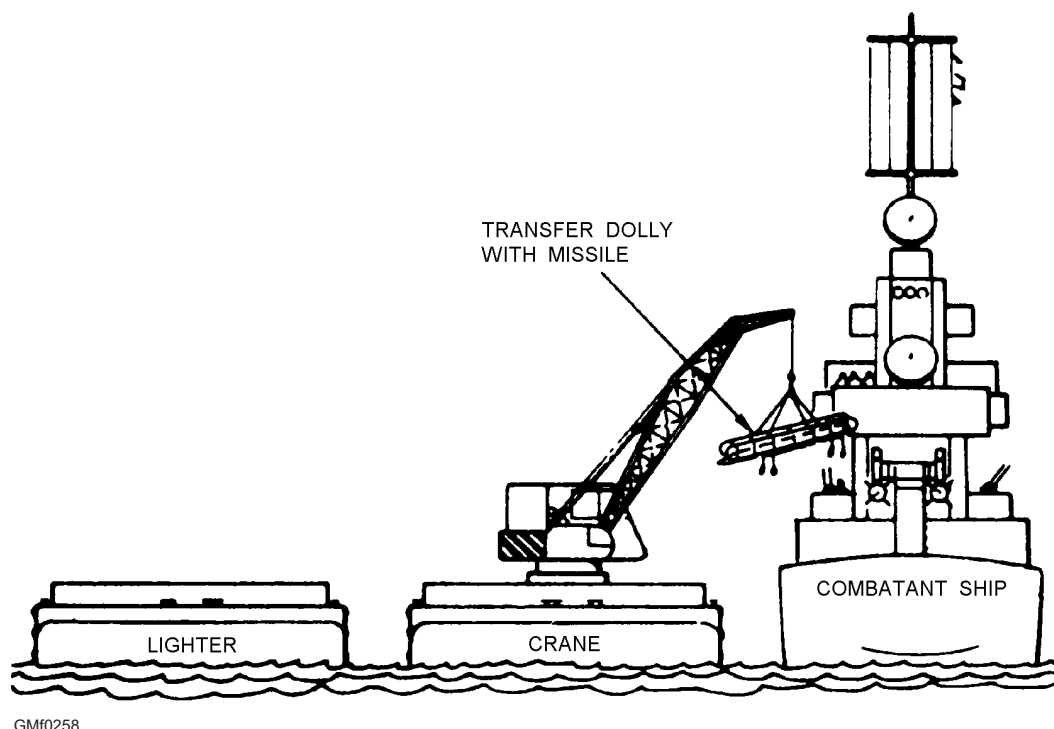


Figure 2-59.—Lighter replenishment.

evolutions are a form of missile handling also. Even though the missile is within the confines of the GMLS, it is still susceptible to damage. Sometimes, due to equipment failure or breakage, missile damage is unavoidable. Fortunately, such cases are extremely rare. Most missile damage is a result of personnel error.

A common cause of damage can be traced to the experienced control panel operator. Loading and unloading a launcher everyday, especially with a GMTR, becomes second nature to some people. They soon learn the "shortcuts" of a GMLS and can "run the panels blindfolded." In short, bad operating habits are developed. Those bad habits are hard to break when a live missile must be loaded. Quite often, a shortcut that can (but shouldn't) be taken with a training missile just won't work with a live missile. You can guess the outcome.

Safe and proper handling/operating techniques **MUST** be practiced constantly. There is no room for error or carelessness, especially in routine shipboard tasks. Eliminate distractions and concentrate on what you're doing.

STOWAGE

You will be responsible for the care of the missiles while they are in stowage. That is an important task since a missile spends about 99 percent of its existence in stowage. A large part of this care is related to maintaining magazine environmental control and fire suppression systems in good working order.

Magazine temperature and humidity levels must be checked. If they begin to exceed established tolerances, positive action must be taken immediately. Be sure to inform your work center supervisor of the situation.

Good housekeeping has to be practiced in any ordnance stowage area. Maximum effort must be made to keep the magazine area clean. Do not let dirt, oil, or greases accumulate to create potential fire hazards. Oily rags are particularly dangerous.

Missile airframes are not watertight structures. That point was emphasized when we discussed training missiles near the end of chapter 6. Live missiles are subject to the same corrosive damage as are training missiles. Although the problem is not as acute with live missiles (because they are handled less), it is just as serious. Don't let the live missile get wet.

Since (live) missiles are in stowage most of their time aboard ship, how can they get wet? Unfortunately, magazine sprinkler wetdown is all too often the cause.

And, as you know, most wetdowns are generally traced to personnel error. We won't repeat the applicable sprinkler warnings, although they cannot be stressed enough. An important point to remember is that ANY wetdown experience **MUST** be immediately reported through the chain of command.

Special measures must be taken if the missiles have been exposed to salt water, as from a wetdown. Each missile must be examined carefully for any evidence of saltwater contamination. Give particular attention to all joints, launching shoes, and firing contacts. DTRMs and boosters that had water enter their bore must not be used. These rounds (with wet rocket motors) must be returned to an NWS.

Corrective action after a wetdown involves washing the missile with fresh water. The missile is then dried and corrosion preventive compounds are applied. Every missile subjected to wetdown must be reexamined within 30 days. Details as to the extent and location of corrosion must be noted in the service record of the missile. If the problems are severe enough and continue to worsen, the missile(s) may be totally ruined. Therefore, after any wetdown, the missile(s) must be turned in to the nearest NWS or missile-handling facility.

INSPECTIONS

You will be required to inspect the missiles at different intervals. Generally, these inspections are visual and are limited to the external surfaces of the round. Inspection procedures and points to check are outlined on maintenance requirement cards (MRCs) or in the applicable Ops. You check different things on different missiles, so be sure to refer to the applicable references.

Normally, missile inspections can be divided into three major periods—receipt, routine, and off-load. These are special inspection situations such as after a casualty wetdown or dud/misfire occurrence. Appropriate MRCs or missile handling Ops exist to provide instructions for these conditions.

The receipt or on-load inspection is very important. Before the missile is moved to the magazine, go over it with a fine-tooth comb. Using an MRC/OP as a guide, check for cracks, dents, chips, and other external surface damage. Ideally, the surface of the radome should be perfectly smooth. But, sometimes, bubbles will appear on its surface. The MRC/OP will give size-tolerances of these bubbles; if they are beyond a certain dimension, the round must not be used.

Ensure all control surfaces are installed and folded correctly. Verify that all safety wiring and protective seals are intact. Antenna surfaces must not be soiled or scratched. If you discover or think you've discovered a problem during a receipt inspection, notify proper authority immediately. If the problem can be verified to be beyond acceptable standards, the ship can reject the missile.

Periodically, every missile must be removed from the magazine and given a routine inspection. The interval of routine inspections may vary, but semiannual and/or annual inspections are most common. Many of the same points checked during a receipt inspection are rechecked. Cleaning and preservation work is also performed. Routine inspections are important checks as they contribute to the long-term reliability of the missile.

An off-load inspection is conducted as the missile leaves the ship. If you have faithfully performed the other inspections, the off-load checks should go rather quickly. The results of any inspection will be logged in a guided missile service record (GMSR). Compare a GMSR to your own health or dental record. Any time you have a physical, the results are recorded to establish your medical history or file. The same thing applies to a missile and its inspection results.

CLEANING AND PRESERVATION

You will be responsible for the cleanliness and preservation of the missiles. These actions are normally performed as part of the routine inspection procedures. Without fail, your missiles WILL get dirty. They'll get stained from oil and grease drippings and even shoe polish scuff marks. Missiles are not cleaned and preserved just to make them "look pretty." This work is accomplished for some very valid reasons. Cleanliness directly contributes to the prelaunch and in-flight performance of the round. For example, we mentioned antennas as an item you had to inspect. Suppose a big glob of grease falls onto a proximity antenna. Yes, that

glob of grease could affect the operation of a warheads fuze by blocking or distorting the transmitted/received signal. What if a movable tail-control surface rusted in place? Steering and stability control would be severely hampered. Items such as these must be checked, cleaned, and preserved.

Cleaning generally involves the use of good old soap and water along with elbow grease. The outer surfaces of the missile are washed to remove any accumulations of unwanted materials. Be sure to consult the maintenance instructions and use the approved detergents. Warnings will often be included stating where abrasive cleansers (like scouring powder) may or may not be used.

Preservation involves applying corrosion preventive compounds to the external surfaces of the missile. These compounds are designed to resist the effects of moisture on a metal surface. The MRC/OP instructions will specify the currently approved materials and explain where and how to apply the compounds.

SUMMARY

In this chapter we explained how the explosive compounds described in chapter 1 are used in modern Navy gun ammunition. We also described how this ammunition is identified with both color coding and lot numbers. We discussed how ammunition stocks are accounted for and what reporting procedures are used by ammunition managers. We looked at some of the different types of stowage magazines and how these magazines are protected with sprinkler systems. We described some of the handling equipment and the training and safety requirements involved in handling ammunition. Finally, we described missile processing and associated handling equipment. For detailed information and/or additional descriptions of the equipment and procedures discussed in this chapter, you should refer to the references cited.